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Other herbs and spices: mango ginger to wasabi

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Abstract: In this second part of the chapter on underutilized spices, nine spices are discussed briefly. They are mango ginger, fragrant pandan, pink pepper, rue, sumac, savory and wasabi. Morphology, chemical composition, medicinal and culinary uses are given briefly in each of these spices. In addition short notes on 12 lesser known spices are provided; these are blue fenugreek, boldo leaves, chameleon plant, cicely, cresses, epazote, finger root, gale, lemon myrtle, Mexican pepper leaf, Tasmanian pepper and water pepper.

Key words: mango ginger, fragrant pandan, pink pepper, rue, sumac, savory, wasabi, less known spices.

28.1 Introduction

Brief reviews on eight herbs and spices are given in this chapter. These spices and herbs are not widely used, and many are restricted mostly to regional cuisines. Spices like sumac are used mainly in the Persian Gulf and Mediterranean regions, while fragrant pandan is prevalent in countries in the Far East and Pacific regions. Pink pepper is a specialty of South and Central American cuisines. Morphologically these spices vary from a rhizomatous perennial herb (mango ginger) to small herbs (rue) to fairly large trees (Californian pink pepper tree). In this chapter, these spices and their role in cooking are dealt with briefly. In addition brief notes are also provided on 12 other minor herbs and spices.

28.2 Mango ginger

Mango ginger (*Curcuma amada* L.) is a rhizomatous, aromatic herb of the ginger family, Zingiberaceae. It is cultivated throughout India, Sri Lanka, and Bangladesh and in many South East Asian countries for its rhizomes, which are used in both fresh and dried form for flavouring pickles and other vegetarian and meat dishes.

It is also valued for its medicinal properties. The fresh cut rhizome has the flavour and the colour of mango, hence the name mango ginger.

Mango ginger is a perennial, which is propagated through rhizomes. The plant reaches 60–90 cm in height; its leaves are long, petiolate and oblong–lanceolate; flowers are white or pale yellow in spikes produced at the centre of the tuft of leaves. The rhizomes have a bitter taste initially, turning sweeter and later becoming sour and aromatic. *Curcuma amada* is similar in taste and uses to the Indonesian species *Curcuma mangga* (Khare, 2007).

28.2.1 Chemical and functional properties

Earlier studies reported variation in the chemical composition of mango ginger rhizome depending upon the region of production. Major compounds identified include ocimene, linalool, linalyl acetate, safrole, curcumene, δ -3-carene, (*Z*)- β - β -ocimene, dihydrocimenes, myrcene and 1,8-cineole. (Chaudhuary *et al.*, 1996; Gupta *et al.*, 1999; Srivastava *et al.*, 2001; Singh *et al.*, 2002; Mustafa *et al.*, 2005). Another study using advanced gas chromatography (GC) and gas chromatography–mass spectrometry (GC–MS) led to the identification of 26 components comprising almost 98 % of the total volatiles (Mustafa *et al.*, 2005). The oil contained ten monoterpenes, three hydrocarbons, four oxygenated hydrocarbons, two ketones and one ester. The predominant monoterpenes are camphor and thymol. The sesquiterpene fraction consisted mainly of hydrocarbons such as (*Z*)- β -farnasene, guaia-6,9-diene, α -pinene and α -longipinene. The aromatic constituent contributing to the flavour is thymol. Jatoi *et al.* (2007) studied the chemical composition of mango ginger from Japan and reported over 130 compounds with biological activities, including anti-oxidant, antibacterial, antifungal and insecticidal properties. Nahar and Sarker (2007) provide an exhaustive list of the chemical constituents of various species of *Curcuma* including *C. amada*.

Mango ginger has many biological activities due to the presence of curcuminoids (curcumin, des-methoxy curcumin, demethoxy curcumin). Curcumin has been shown to be associated with a large number of physiological and medicinal properties (Aggarwal *et al.*, 2007; Jatoi *et al.*, 2007). It is known as a carminative, expectorant and antipyretic, and can stimulate the appetite. Studies have shown that curcumin (as well as its main source, turmeric) has a variety of biological activities, especially under *in vitro* cell culture and in animal systems.

Curcumin has a significant effect on different cell signaling pathways (such as, for example, its impact on the NF κ B signalling pathway, inhibition on the AP-1 signaling pathway, modulation of the cytochrome *P*-450 pathway and inhibition the growth factor pathway). The anticancer properties of curcumin against some types of cancer cells have been tested and proved under *in vitro* systems. It was shown to inhibit the proliferation of breast cancer cells, colon cancer cells, prostate cancer cells and kidney cancer cells and to induce apoptosis in many cancer cells. It has also been found to enhance the chemosensitivity and radiosensitivity of cancer cells.

Curcumin is useful in cardiovascular-related ailments such as hypercholesterolemia and platelet aggregation: the rhizome extract was reported to exhibit a hypocholesterolemic effect in rabbits (Pachuri and Mukherjee, 1970). Majumdar *et al.* (2000) demonstrated the anti-inflammatory activity of mango ginger rhizome extract

in rats, and many other studies have also indicated that mango ginger extract exhibited strong inhibitory activity on bacteria and moulds (Sayyad and Chaudhari, 2010).

It has been found to be very effective in muscle regeneration and in wound healing, and is recommended for use in rheumatism, concussion and sprains (Khare, 2007). Curcumin is also effective in treating inflammation of the liver and in protecting the liver from alcohol- and drug-induced injury. A significant reduction in total lipids and serum triglycerides in the liver of adult female rats was observed when fed with 10 % mango ginger or 10 % curcumin in a normal diet or in a sucrose-based hyper-triglyceridemic diet (Khare, 2007). Lastly, one of the most noteworthy features of curcumin is its activity against Alzheimer's disease.

28.2.2 Culinary uses

The rhizome of mango ginger is a popular spice and vegetable due to its rich flavour, which is described as sweet with subtle earthy floral and pepper overtones and similar to that of raw mango. It is a delicious addition to salads and stir fries. It is used in South Asian and South East Asian as well as Far East Asian cuisines and, most commonly, in Thai cooking. In India, it is most widely used in chutneys and pickles. It is prepared for use in cooking like fresh ginger. Some of the dishes found on popular recipe websites in which mango ginger is used as a flavour and spice are: Kondaikadalai pachadi, mango ginger gravy, mango ginger pickle, grilled pan chicken with fiery mango ginger salsa, gingerbread cupcakes with mango ginger icing, hot grilled shrimp with mango ginger sauce, couscous cake with fresh mango ginger chutney, grilled Thai chicken salad with mango ginger, spicy mango ginger tofu, mango ginger sorbet.

28.3 Fragrant pandan

Fragrant pandan (also known as pandan wangi and fragrant screw pine) belongs to the screw pine family. It is an ancient cultigen which has never been found wild (Setyowati and Siemonsma, 1999). It might have originated from the Moluccas in Indonesia and is now grown in Sri Lanka, Thailand, India, Malaysia, Indonesia, the Philippines and probably in many other tropical and subtropical countries. Fragrant pandan is the only species of *Pandanus* with fragrant leaves, and it is non-flowering in all the cultivated regions except in the Moluccas. Throughout Southeast Asia, it is used in cooking to impart flavour and colour to rice, sweets, jellies, and in many other food products. It is widely used to flavour ordinary rice as a substitute for the expensive aromatic rice varieties (Setyowati and Siemonsma, 1999).

Fragrant pandan grows in two sizes, small and large. Both are perpetuated by suckers. In the small type, the stem is slender, 1–1.6 m tall, 2–5 cm in diameter, decumbent and ascending, producing many aerial roots. The large type produces an erect stem, 2–4.5 m tall, c.15 cm in diameter, sparsely branched, producing prominent prop roots. The taste and flavour quality are the same in both growth forms. The small form is usually cultivated, grown by suckers or by stem cuttings. It is usually grown mixed with various other crops in the home garden, and large plantations do not exist. Harvesting of leaves can start 6 months after planting. Individual

leaves are cut for use, leaving a tuft of four to five leaves at the top of the plant, and are marketed fresh. A mixed plantation of fragrant pandan may give approximately 60 kg fresh leaves per harvest or 6 tons/ha per year. It is also an ornamental plant and its leaves can be used for basket weaving.

Pandan leaves yield a very small amount of essential oil consisting of 6–42 % sesquiterpenes, hydrocarbons and 6 % linalool. The oil contains about 10 % of the aromatic compound, 2-acetyl-1-pyrroline, which is responsible for the aroma of pandan leaves (Buttery *et al.*, 1983). Pandan leaves also contain alkaloids such as pandamarine, and three pandamarilactones (pandamarilactone-1, 31 and 32) (Nonato *et al.*, 1993). More alkaloids and their derivatives were later identified in pandan leaves grown in Thailand and Jami (Indonesia). Pandan leaves are also rich in antioxidant carotenoids such as neoxanthin, violaxanthin, α -carotene, β -carotene, lutein, zeaxanthin and vitamin E analogues. Lutein is present in the highest concentration and is mainly responsible for the antioxidant property of the leaves. Pandanin is a lectin-type protein present in the leaves (Wongpornchai, 2006).

The fresh leaf has no aroma and flavour; flavour develops when the leaf is withered and when cut into pieces. This flavour development is due to a volatile product of the oxidative degradation of a yellow carotenoid pigment that forms only when the plant withers. The leaves have a pleasant aroma, similar to fresh hay, similar to the scent found in some aromatic rice varieties grown in South East Asia (such as Thai jasmine rice and Khao Dawak Mali 105). However, dried pandan leaves lose their fragrance quite quickly (Routray and Rayaguru, 2010).

28.3.1 Functional properties and medicinal uses

Pandan leaves are important in the traditional medicine of South East Asian and Far East Asian countries. The leaves are soaked in coconut oil for several days and the oil is then used in the treatment of rheumatic problems. An infusion of leaves is taken internally as a sedative in restlessness, and it is also indicated in curing internal inflammations. It is used in the treatment of weak nerves (neurasthenia), lack of appetite, hair loss and to darken hair and prevent dandruff. In Thailand, pandan leaves are used as a traditional medicine for treating diabetes. The mode of administration is usually as juice or as a concentrated infusion taken with or without the addition of sugar. Locally it is also used as a treatment for wounds, as an antipyretic, to relieve headache and earache, as a laxative for children, for relief from chest pains, in helping women to recuperate after delivery and in reducing stomach spasms (Wongpornchai, 2006; Anon., 2012a).

28.3.2 Culinary uses

Fragrant pandan, as mentioned earlier, is used extensively in South East Asian and Far East countries to impart aroma to ordinary rice. Juice expressed from the leaves is used to impart flavour and colour to foodstuffs. Pandan leaves release their aroma when sliced, and have a subtle grassy-nutty flavour, making them suitable for use in pot pourris alongside flower petals, especially rose. They are widely used in many Asian countries, such as Indonesia, Malaysia, Thailand, Philippines, Singapore, Sri

Lanka, India and even in Australia in a variety of dishes, including rice dishes, puddings, beverages and curries. *Nasi lemak*, *nasi kuning* and *nasi padang* are some of the pandan leaf-flavoured rice dishes widely eaten in Malaysia and Indonesia, and the leaf paste is used in green Thai and Malaysian curries; the flavour goes very well with coconut milk, glutinous rice, lemon grass, milk, brown sugar and turmeric. In India, pandan leaves, as well as pandan flowers from the related species *Pandanus fascicularis* (common screw pine, the *Ketaki* flower), are used to perfume biryani and other rice dishes and also used in spice blends. Pandan leaves are also used as wrappers in South East Asian cooking in order to provide a distinct flavour to foods. They are wrapped around chicken, pork, fish and desserts before grilling, roasting, barbecuing or steaming. The leaves also provide the green colour and flavour in Indonesian, Thai, Malaysian and Nonya-style rice baked desserts, candies, puddings, soups and coconut milk. In fact, all over South East Asia, the most important culinary application of pandan leaves is in desserts (Anon., 2012a). In Indonesia, pandan leaves are made into ice cream-like concoctions. Pandan leaves are also used in sweet puddings or custards based on sticky rice covered in thick coconut milk (Routray and Rayaguru, 2010). Indian desserts such as *rasagolla*, *gulab jamun* and *rasmalai* also often contain pandan leaf. Many dishes containing pandan leaf flavouring can be found on well-known recipe sites, including: coconut pandan rice custard, coconut pandan chiffon cake, pandan fudge cake, Thai pandan chicken, chicken wrapped in pandan leaves, Thai pandan custard, nasi kuning – festive yellow rice, Indonesian rice with pandan, lod-chong nam ka-ti (pandan noodles with coconut milk), buko pandan, pandan waffle, Thai pandan chicken, pandan coconut muffins.

28.4 Pink peppercorn

Pink pepper is derived from two species of the genus *Schinus*. Brazilian pink pepper is derived from *Schinus terebinthifolius*, which belongs to the cashew family. California pink pepper (also known as Peruvian pepper or American pepper tree) is derived from *S. molle*. Both are known as pink pepper and are used for similar purposes. The Brazilian pepper tree is native to Brazil, Argentina and adjoining regions. It was introduced into the USA as an ornamental tree; in areas such as Florida it has run wild, and has also become naturalized in many other tropical and subtropical countries (Langeland and Burks, 1998). The pink pepper tree is highly drought resistant and has become one of the most aggressive and widespread invasive weed species, extending over vast areas in the USA and displacing the native plants. This species invades aquatic as well as terrestrial habitats, greatly reducing the quality of native biotic communities (MacDonald *et al.*, 2008).

The Brazilian pepper tree is a small evergreen tree, having alternate, compound leaves, with a turpentine-like aroma. This species is dioecious; male and female flowers are produced on separate trees and are borne on large panicles. The fruit is a fleshy drupe, which turns bright red when ripe, while the pulp is brown in colour and aromatic (Kramer, 1957; NIIR Board, 2002). The tree produces a large quantity of seeds that are dispersed by animals and birds.

The American pepper or Californian pepper (*S. molle*) is native to the arid zone of northern South America, Mexico and the Andean deserts of Peru, spreading as far as central Chile and central Argentina. It has become widely naturalized around the world where it has been planted both as an ornamental and for spice production. *S. molle* is a drought-tolerant, long-lived, hardy evergreen species that has become a serious invasive weed internationally (Iponga *et al.*, 2008). This is a much larger tree than the Brazilian pink pepper, but has similar morphological characteristics and chemical composition.

28.4.1 Chemical and functional properties

Chemical analysis led to the identification of 57 and 62 compounds in the oils of *S. molle* and *S. terebinthifolius*, respectively. The main constituents of these oils are: α -phellandrene (46.52 % and 34.38 %, respectively), β -phellandrene (20.81 % and 10.61 %), α -terpineol (8.38 % and 5.60 %), α -pinene (4.34 % and 6.49 %), β -pinene (4.96 % and 3.09 %) and *p*-cymene (2.49 % and 7.34 %). A marked quantity of γ -cadinene (18.04 %) was also identified in the *S. terebinthifolius* essential oil, whereas only traces (0.07 %) were detected in the essential oil of *S. molle* (Bendaoud *et al.*, 2010). The oil of *S. terebinthifolius* was reported to be more effective as an antioxidant and also against certain cancer cell lines tested (Bendaoud *et al.*, 2010). Both pink peppers cause allergic reactions such as skin irritations and respiratory difficulties when the tree is in bloom, and allergic reactions can also result from excessive consumption. This allergic property seems to be due to the presence of urushiol-type allergens, but the spice grown in Réunion appears to be free of urushiols, and the less effective cardanols (3-alkylphenols) were found in lower concentration than in Florida-grown pink pepper (Katzner, 2002). Extract of this plant is a powerful bactericidal agent (Siddique *et al.*, 1995).

Pink peppers are important medicinally and are used in traditional local cures. They are used in treating a variety of wounds and ulcers due to their antibacterial properties, and have been used as an antidepressant and diuretic. They are also used in treatments for toothache, rheumatism and menstrual disorders. Recent studies are providing some support for their use as an antidepressant, while other research is also focused on their potential for use as natural insecticides (Katzner, 2002).

28.4.2 Culinary uses

Pink pepper is a spice used in a variety of dishes in Brazil, Mexico, Argentina, Peru and other areas of Latin America. The flavour of the pink berries (also marketed as pepper rosé) is rather weak, and so these berries serve a predominantly ornamental purpose, although they can develop a subtle flavour in food that has little other flavouring added (Katzner, 2002). A number of recipes using pink pepper can be found on recipe sites, including the following: miso cod with deep fried cabbage and pink peppercorn dressed cabbage; peppercorn salmon; smoky lamb kebabs; ceviche with crab salad and ciabatta; Sardinian octopus; pan-fried sea bass; duck fillets; roasted duck breast with pink peppercorn sauce; peppered duck; salt marsh lamb with woodland mushroom and sorrel; spiced pork burgers.

28.5 Rue

Rue (*Ruta graveolens* L.; citrus family–Rutaceae) is a hardy, shrub-like evergreen plant, which is native to Southern Europe. Rue can grow in almost any conditions, but prefers a semi-sheltered dry environment. The lower part of the stem is woody, and the leaves are alternate, bluish-green and either bi- or tripinnate. They have a strong unpleasant odour and a very bitter disagreeable flavour. The plant blossoms from June–September, with greenish yellow flowers. Propagation can be carried out by direct seed planting, stem cuttings or root cuttings.

The whole herb is used as for medicinal purposes, the drug consisting of both the fresh and the dried herb, and may also be used in cooking in some regions. The shoots are gathered before the plant flowers, with the young shoot tops considered the most valuable. The volatile oil present in the herb is contained in glands distributed over the whole plant, and is distilled from the fresh herb, as are decoctions and infusions. The dried herb has a similar taste and odour, but is less powerful. Its powder is used for making tea.

28.5.1 Chemical properties

The main active principles of the plant are: glycosides, such as the flavonoid rutin; alkaloids, such as coquisagenine, skimmianine and graveoline; furocoumarins (psoralens), such as bergaptene (3-methoxypsoralen) and xantotoxine (8-methoxypsoralen); essential oils-containing compounds, such as methyl-nonyl-ketone, methyl-*n*-octyl-ketone and methyl-heptyl-ketone; alcohols, such as methyl-ethyl-carbinol, pinene and limonenes; and other compounds, such as dictamine, gammafagarine, pteleine and kokusagenine (Pronczuk, 1989). Soleimani *et al.* (2009) carried out a chemical analysis of the essential oil of rue plant and reported that the main classes of compounds are ketones (46.6%), sesquiterpenoids (13.3%) and monoterpenoids (4.1%). The major constituents were 2-undecanone (33.9%), 2-heptanol acetate (17.5%), 1-dodecanol (11.0%), geyrene (10.4%) and 2-nonanone (8.8%). The active principles of clinical importance are the psoralens, responsible for hepatotoxicity and photosensitization and methyl-nonyl-ketone, which accounts for the effects on the uterus. Rutin has the effect of supporting and strengthening the inner lining of blood vessels and reducing blood pressure.

28.5.2 Functional and medicinal properties

Rue is a traditionally used medicinal plant and is used in Indian traditional medicines (Ayurveda, Unani and Siddha) and in herbal medicine in many other countries, although its use in developed countries is now minimal. Khare (2007) provides the following list of its medicinal properties and uses, primarily in Indian traditional medicine:

- **Herb:** Stimulating, antispasmodic, stomachic, irritant, abortifacient; used as an emmenagogue and for the treatment of cough, colic and flatulence.
- **Leaf:** Used in amenorrhoea, menorrhoea, and colic; used externally for sciatica, headache, muscular chest pain, bronchitis, arthritis.
- **Oil:** Antispasmodic, anti-epileptic, emmenagogue, rubifacient.

The primary use of rue in Latin American traditional medicine is to stimulate menstrual flow by invigorating the muscles of the uterus: pregnant women should therefore avoid consumption of rue. It is also widely used in the treatment of eye problems; an infusion of the herb relieves tired and strained eyes and is believed to help improve vision. It has been used in the treatment of disorders of the nervous system such as multiple sclerosis and Bell's palsy, as well as in curing dizziness and vertigo. Rue is beneficial in treating gastrointestinal complaints such as colic and flatulence; in these cases, rue essential oil should be taken internally, mixed with water and sugar. If an overdose is taken, the herb acts as an acro-narcotic poison. It also tends to induce vomiting; any treatment should therefore not be taken directly after eating. Externally, it can be used as an ointment, while the leaves help to relieve pain caused by sciatica. Fresh leaves placed on the forehead are said to cure headaches, and a compressed and saturated decoction prepared from rue leaves applied to the chest helps in treating persistent bronchitis. Chewing rue leaves helps to eliminate bacteria on the gums (Grieve, 1931b).

28.5.3 Culinary uses

Katzer (2000a) provides a detailed discussion of the uses of rue in cooking:

Apart from occasional use in Italy, rue's popularity is greatest in Ethiopia. Fresh rue leaves are sometimes used as a coffee flavourant (remember that coffee is probably native to Ethiopia), and rue is also sometimes mentioned as a component in the national spice mix, *berbere*. Ethiopian cuisine is unique in using not only rue leaves, but also dried fruits (rue berries) with their more intensive, slightly pungent flavour that is well preserved on drying.

To cook with rue is usually considered old-fashioned, which is probably because half a century ago, rue was significantly more popular than today so that it is seen a leftover from past times; second, older people frequently develop a positive attitude towards bitter taste and tend to use bitter herbs and spices more liberally. And yet, rue is definitely worth a try; meat, eggs and cheese all can profit from this nearly unknown spice, provided care is taken not to overdose. The bitter taste is reduced by acids; thus, a leaf of rue may be used to flavour pickled vegetables, make a salad more interesting or add a very personal touch to home-made herbal vinegar.

Because of its general affinity to acidic food, rue goes well with spicy Italian tomato sauces containing olives and capers (together with marjoram, basil and lovage). If a cook wants rue flavour without bitterness, he might make use of the fact that rue leaves excrete the essential oil much more quickly than the bitter rutin (very similar to tea leaves). Thus, the fresh leaves may be soaked in a slightly boiling sauce for a short time (typically, one minute) and discarded afterwards. By this a procedure, a maximum of flavour at a minimum of bitterness is achieved...

Like many other bitter spices ... rue is popular for flavouring liquors. Besides stimulating the appetite, bitter liquors have some tonic, stomachic and even bile-stimulating properties, all of which are advantageous after a rich feast. One of the most common liquors containing rue is grappa con ruta, an Italian draft brandy flavoured with a small branch of rue per bottle. For this, the related Fringed Rue (Aleppo rue, *R. chalepensis*) is usually preferred.

Below is a list of recipes found on popular recipe sites that use rue as a flavouring ingredient: peas with rue (rantas borbszho), cheese-rue casserole, scotch rues, potato soup, seafood gumbo, clam chowder, lentil soup, sauerkraut and bean soup, seafood

au gratin, linguini and white clam sauce, broccoli cheese soup, cheese soup, rue spice cake, ancient Roman-style garlic cheese with rue, endives wrapped in ham, etc.

28.6 Sumac

Sumac (*Rhus coriaria* and related species; cashew family–Anacardiaceae) is a very popular spice in countries of the Middle East, where it is widely used in rice, vegetable and meat dishes and in desserts. Sumac is used in most Arab countries, and has spread from there to a number of regions across the world. The term sumac is derived from the Arabic root, *summaq*, meaning red, referring to the colour of sumac fruit. Sumac belongs to the genus *Rhus*, found in subtropical and temperate regions throughout the world. Many species are used as a spice, the most important being Sicilian sumac, *Rhus coriaria*. Other species used include Chinese sumac (*Rhus chinensis*), smooth sumac (*R. glabra*), Staghorn sumac (*R. typhina*), fragrant sumac (*R. aromatica*), lemonade sumac (*R. integrifolia*), sugar sumac (*R. ovata*) and Muller's sumac (*R. mulleria*) among others. Sumac plants are large shrubs or small trees, reaching a height of 3–10 m, with pinnately compound leaves. They bear greenish white flowers in dense panicles and red drupaceous fruits (also called sumac bobs), from which the spice is derived. Sumac is an invasive species that has spread over large stretches of land in many areas of the USA, where it has proved difficult to eradicate.

28.6.1 Chemical and functional properties

Sumac fruits, leaves and bark contain many components (Brunke *et al.*, 1993). Sixty constituents have been identified in the essential oil extracted through hydrodistillation of *R. coriaria* leaf (principally β -caryophyllene (0.33–16.95 %) and a sesquiterpene hydrocarbon, patchoulane (3.08–23.87 %)); 63 in the essential oil from the bark/branch (mainly β -caryophyllene (12.35–21.91 %) and cembrene (10.71–26.50 %)); and 85 in the essential oil from the fruit pericarp (principally limonene (0.17–9.49 %), nonanal (10.77–13.09 %) and (*Z*)-2-decenal (9.90–42.35 %)). The composition of oils from two different phytogeographic regions showed variations (Rayne and Mazza, 2007; Kossah *et al.*, 2009). Brunke *et al.* (1993) studied the chemical composition of Syrian and Chinese sumac and reported a large number of compounds in their oils. They found the main constituents to be terpene hydrocarbons (i.e. α -pinene, β -caryophyllene and cembrene), oxygenated terpenes (i.e. α -terpineol, carvacrol and β -caryophyllene alcohol) as well as farnesyl acetone, hexa-hydro-farnesyl acetone and aliphatic aldehydes.

The flavour characteristics of ground sumac are described as 'oil and acid aroma, dried lemon balm, cellulose/ woody, spicy, earthy and astringent' (Bahar and Altun, 2009). The astringent–acidic flavour of sumac spice is mostly caused by two different types of constituent: tannins (gallotannins, with a total content of 4 %) and organic acids (malic, citric and tartaric acid, along with smaller amounts of succinic, maleic, fumaric and ascorbic acids). The sensory and flavour profile analysis carried out by Bahar and Altun (2009) indicated that the malic acid present in sumac fruit is mainly responsible for its sour taste. β -caryophyllene contributes both the spicy and

woody flavour; cembrine, the woody flavour and caryophyllene oxide, the spicy flavour. The fruit wall (pericarp) is dark red and contains anthocyanin pigments, including chrysanthemine, myrtillin and delphinidin.

Sumac fruits (as well as all other plant parts) contain the group of chemicals known as urushiols (3-alkyl pyrocatechol derivatives), which are powerful allergens. Sumac can cause painful dermatitis in sensitive people, and the toxins are effective in sub-microgram amounts. Lethal poisonings have been reported, particularly on ingestion or inhalation, which allows the urushiols to attack the mucous membranes of the mouth, nose and intestines (Katzner, 1998b).

Sumac is used medicinally in Arab countries. Studies on sumac extracts to date have indicated that the plant may be a source of bioproducts with the following bioactivities: antifibrogenic, antifungal, anti-inflammatory, antimalarial, antimicrobial, antimutagenic, antioxidant, antithrombin, antitumorogenic, antiviral, cytotoxic, hypoglycaemic and leukopenic (Rayne and Mazza, 2007).

Sumac extracts, as well as the extracts of other species of *Rhus*, are most notable for their antimicrobial activities. In one study, crude methanolic extracts of *R. glabra* branches exhibited both the widest zones of inhibition in a disc assay, and the broadest spectrum of inhibition (active against the species of bacteria tested: *Bacillus subtilis*, *Enterobacter aerogenes*, *Escherichia coli* DC2, *Klebsiella pneumoniae*, *Mycobacterium phlei*, *Pseudomonas aeruginosa* H187, *Serratia marcescens*, *Staphylococcus aureus* and *Salmonella typhimurium* TA98) (Rayne and Mazza, 2007).

28.6.2 Culinary uses

Sumac is widely used as a spice throughout the Middle East, and its use in cooking has also spread to the Iberian peninsula. Often it is simply provided as a condiment to be sprinkled on food at the table. In Turkey and Iran, sumac is often put on the table in shakers or bowls, especially in kebab houses, and is used like salt and pepper are used in the west, to improve the flavour of meat dishes, curries, fish, vegetables, rice, salads, stews and sauces and, combined with onions and salt, as a seasoning for roast meat. In other Arab countries, particularly in the Eastern Mediterranean, sumac is mixed with sesame seeds, salt and thyme or hyssop in the popular spice mix called *za'atar* (also spelled *za'htar*), used as a seasoning for fried and barbecued meat, or combined with olive oil for use as a dip for breads (Katzner, 1998b). In Egypt, it sometimes appears in another spice mix called *dukkah* (spelling varies). In addition to being used as a condiment, sumac is also commonly rubbed on meats, chicken or fish, added to marinades and used to increase the acidity in yogurt sauces or vinaigrettes. It is used for the enhancing taste and flavour of egg dishes and salads and, because it provides an attractive red colour, it is used as a decorative garnish on dishes such as hummus and other dips.

Native Americans also use the fruits of smooth sumac and staghorn sumac (*R. glabra* and *R. typhina*) to make a beverage known as sumac-ade, Indian lemon-ade or rhus juice. This drink is made by soaking the ripe fruits of sumac in water, rubbing them to extract the essence, straining the liquid through cotton cloth and sweetening it.

Examples of dishes using sumac, taken from various sources, are as follows:

Azerbaijanis herbed potato slices, za'atar spice blend, devilled eggs with tahini, shawarma, mousakhan (Palestinian chicken), Middle Eastern-style lamb pizzas, fat-toush (Middle Eastern salad), parsley and sumac salad, spiced kumara (sweet potato) dip with crisp flatbread, Middle Eastern thyme breads, sumac onions, roasted red capsicum soup, tofu sour cream, piyaz (Turkish black-eyed pea salad), Turkish potato salad, chicken thighs in yogurt and onions, African spice mix, gavurdagi.

28.7 Summer savory and winter savory

The genus *Satureja* (*Satureja* spp. L.; sage family–Lamiaceae) comprises about 14 species of highly aromatic, hardy annual or perennial herbs or under-shrubs. Two important species of this genus are *S. hortensis* (summer savory) and *S. montana* (winter savory), with the former more widely used; hence this discussion is mainly on summer savory.

Summer savory is a hairy aromatic annual, grown as a popular garden herb, while winter savory is a semi-evergreen bushy and woody perennial shrub, with a stronger flavour. Savory is indigenous to southern Europe and the Mediterranean area, and is now distributed across the warmer regions of both hemispheres, growing wild in dry, light soils and on rocky hillsides on chalk. It is locally cultivated for commercial use, with France, Albania and countries of the former Yugoslavia the major producers (NIIR Board, 2002). Savory is also cultivated in Spain, Germany, and other parts of continental Europe, England, Canada the USA and in India, in Kashmir, although the variety grown in the former Yugoslavia is recognized as the premier grade.

Summer savory plants grow to 30–60 cm tall, and have slender green leaves with lilac tubular flowers, while winter savory can reach over 200 cm tall, has a woody stem and pale pink to white flowers. Both types can be propagated clonally, from cuttings or divisions of the root, or preferably through seeds. They are cold-sensitive, preferring a cool climate, full sun and rich and light soil. Harvesting of leaves can start 75–120 days after sowing; the harvest is dried in shade or at 35°C and stored in closed containers. The dried leaves are brownish green in colour and are fragrantly aromatic, with a warm, slightly sharp taste. The flavour of winter savory tends to be more bitter than that of summer savory. In commerce, the plant is marketed in a number of forms: the plant as harvested at flowering time and dried; freshly harvested leaves and flowering tops, collected during the flowering season; the leaves harvested before flowering; or the whole ground dried leaves and flowering tops.

28.7.1 Chemical and functional properties

The chemical properties of the fresh leaves differ from those of the dried commercial product. Fresh summer savory leaves contain moisture (72 %), protein (4.2 %), fat (1.65 %), sugar (4.45 %), fibre (8.60 %) and ash (2.11 %). The commercial product should have the following specifications: about 10 % total ash, 2 % acid insoluble ash, 10 % moisture, 25 ml volatile oil per 100 g and granulation 95 % (95 % of the ground product should pass through a US standard sieve No. 40).

The leaves on a dry weight basis contain 11.95 % pentosans and also labiatic acid, ursolic acid, β -sitosterol and volatile oil. There are many reports on the composition of essential oil of the aerial parts and leaves of savory from different parts of the world (Opdyke, 1976; Gora *et al.*, 1996; Hajhashemi *et al.*, 2000). The essential oil distilled from the full flowering spice is between 0.1 and 0.15 %. Savory oil is described as light yellow to dark brown liquid, and it comprises carvacrol, *p*-cymene, pinene, dipentane, ursolic acid, etheral oil, phenolic substances, resins, tannins and mucilage (Prakash, 1990; Karnick, 1994). Lawrence (1981) compared the chemical composition of savory oils from Europe, Canada and North Africa. The oil exhibited differences in *p*-cymene, myrcene and γ -terpinene contents. Prakash (1990) carried out a comprehensive literature survey on the chemical composition of savory oil.

Seed oil of summer savory is also a commercial product. Seeds contain fixed oil (45 %) and protein (24 %) on a dry basis. Ghannadi (2002) analysed the seed oil of savory collected from Iran using GC and GC-MS. The seeds yielded 0.3 % of pale yellowish oil with a pleasant spicy odour. Forty-two components were characterized, representing 96.7 % of the total oil. The major components were carvacrol (59.7 %), γ -terpene (12.8 %), *p*-cymene (9.3 %) and α -terpinene (2.1 %). Gora *et al.* (1996) analysed a sample from Poland and reported the following compounds: γ -terpinene (40.9 %), carvacrol (39.3 %), *p*-cymene (6.2 %), α -terpinene (4.0 %), myrcene (2.5 %), α -thujene (1.9 %), α -pinene (1.5 %) and smaller quantities of β -caryophyllene, β -pinene, β -bisbolene and limonene. Many of these compounds are also common in the oil from the vegetative parts. Pfefferkorn *et al.* (2008) reported variations in the chemical composition of the oil depending upon the developmental stages of the plant.

The properties of savory as summarized by Khare (2007) include: carminative, digestive, laxative, stomachic, diuretic, sudorific and vermifuge. It is used as a treatment for colic and flatulence, and to regulate or suppress menstrual bleeding. An infusion (savory tea) is given as a carminative and expectorant (Karnick, 1994). Essential oil distilled from the aerial part has antibacterial, antifungal and spasmolytic properties, while the labiatic acid present in the plant is an antioxidant. *In vitro* studies provided some evidence for the antibacterial, antifungal, antispasmodic, antidiarrheal and anti-inflammatory activities of savory essential oil (Adiguzel *et al.*, 2007). The main active ingredients seem to be carvacrol and thymol. Finally, the flowering stalks are also used as a moth repellent for clothes.

28.7.2 Culinary uses

Savory has a distinctive taste, somewhat similar to that of marjoram, and has been used in cooking since Roman times. It is now used extensively in western Asia, Europe, the Middle East, the USA and Canada, but is less common in the cuisines of tropical Asia and in South and Far East Asian countries. The leaves are used as a seasoning in meat dishes and stuffings, and sprigs of the plant are boiled with peas, beans and cabbage to improve their digestibility (Verghese, 2003; Katzer, 2007). It has also been used as a garnish, as a substitute for parsley and chervil and in liqueurs.

Popular websites provide an extensive list of dishes in which savory is used; a small selection of these is provided below:

- Meat dishes, such as crock pot chicken with blue cheese and mustard sauce, veal stew à la hongroise, herbed lemon spareribs, summer savory perfumed roast pork loin, capitolade of chicken, Newfoundland fishcakes and Quebec meat pie.
- Vegetable dishes, such as vegetable paté, pan-fried peppers with fancy grits, mushroom bruschetta, spinach and artichoke casserole, blue cheese and spinach puffs, skillet squash and onions, black-eyed pea and corn chowder, and mushroom lentil barley stew.
- Seasonings and condiments, such as herbs de provence seasoning, savory cranberry stuffing, turkey stuffing and Italian-style seasoning.
- Soups, such as Michigan asparagus soup, tomato rice soup and Cape Verde vegetable soup and green string bean soup.

28.8 Wasabi

Wasabi (*Wasabia japonica* (Miq.) Matsum; mustard family – Brassicaceae), also known as Japanese horseradish, is a native aromatic herbal spice crop of Japan. The natural distribution of wasabi ranges from Russia's Sakhalin Island, north of Hokkaido (the most northern Japanese island) to Kyushu (the southernmost major Japanese island). However, the Shimane region is the largest area of wasabi production and breeding research in Japan at present. Wasabi is now being grown in many countries in the world, including New Zealand, Taiwan, Korea, Israel, Brazil, Thailand, Columbia and the Vancouver region of Canada and in Oregon, USA. However, Japanese wasabi is still considered as the best quality variety. Horseradish (*Armoracia rusticana*) is a widely used adulterant and substitute for wasabi.

The genus *Wasabia* consists of two species, the cultivated wasabi (*W. japonica*) and the wild, uncultivated wasabi (*W. tenuis*). *W. japonica* is a glabrous, perennial aromatic herb that grows about 45 cm high, producing leaves on long petioles from the crown of the plant. Wasabi crop matures after 18 months when the plants have thickened rhizome. According to some Japanese farmers wasabi has nine well-known cultivars: Mazuma, Daruma, Takai, Shimane, Midori, Sanpoo, Izawa Daruma, Medeka and Hangen (Oates, 2008). Daruma is the most popular variety, known to grow well under marginal environmental conditions, such as warmer temperatures. For poor quality locations, researchers developed cultivars like Fuji Daruma, Izawa Daruma, Ozawa Daruma and Sanpoo. Wasabi is grown in two ways: in water and in soil. The water-grown type is considered superior and this is known as *sawa wasabi*; the lower quality land grown wasabi is known as *oka wasabi* (Oates, 2008; Sultana and Savage, 2008).

28.8.1 Chemical composition

The characteristic flavour of wasabi, similar to that of mustard leaves, is due to the presence of a group of compounds known as isothiocyanates. Wasabi (along with European horseradish and other members of the Brassicaceae family) contains the precursor of the isothiocyanates, namely glucosinolates, which are glucosides present in the vacuoles of the wasabi plant. When the tissue gets damaged or cut or ground, the glucosinolates are acted upon by the enzyme myrosinase. Isothiocyanates are the

final product of this enzymatic reaction, which is aided by neutral and alkaline conditions. Wasabi contains several types of isothiocyanates, and the flavour quality of wasabi varieties differ depending upon the relative concentration of these compounds. So far, about 116 isothiocyanates have been reported in wasabi (Masuda *et al.*, 1996; Anon., 2011).

28.8.2 Medicinal properties

Wasabi has been grown and eaten in Japan for centuries. It is believed that the daily consumption of wasabi improves the health and helps fighting a large number of ailments. Many studies on the actions of the ingredients of the wasabi plant confirmed the plant's medicinal properties and its usefulness as a nutraceutical. The active ingredients in wasabi are thought to be able to destroy a number of different types of cancer cells, to reduce the possibility of getting blood clots and to have antimicrobial properties. A great deal of research has been carried out into the medicinal properties of wasabi and its active ingredient, isothiocyanate derivatives, especially on 6-methylisothiocyanate, which is found in a relatively high concentration in wasabi. Such studies, combined with traditional knowledge, are providing some insight into the uses and the actions of wasabi in the human body. The following are the major biological effects of wasabi and the isothiocyanates (ITCs) contained in it (Depree *et al.*, 1998; Nagel and Oates, 2007; Anon., 2011). The medicinal properties of wasabi are excellently summarized by Nagel and Oates (2007); details are also available in the website of Wasabi world. The major properties are given below.

Anti-inflammatory effects

Wasabi can control seasonal allergies, asthma and eczema (Nagel and Oates, 2007). ITCs present in wasabi are effective agents for suppressing inflammation based on their rapid action and the low levels needed. 6-MITC (6-methyl isothiocyanate) can inhibit lipoxygenase, cyclooxygenase and cyclic AMP phosphodiesterases that are involved in inflammation. Studies have shown that wasabi isothiocyanates (along with other members of the mustard family like horseradish), have strong anti-inflammatory and anti-asthmatic effects. Natural health practitioners suggest that Wasabi can be an effective treatment for seasonal allergies as well as asthma and eczema.

Antimicrobial effects

As reported (Nagel and Oates, 2007), the isothiocyanates present in wasabi have an inhibitory effect on many bacteria, yeasts and fungi. The compound 6-MITC from wasabi extracts have potent antibacterial properties against *Staphylococcus aureus*, *Escherichia coli* and *Streptococcus mutans*, which is responsible for dental cavities. Wasabi extracts inhibit various strains of *Helicobacter pylori*, the bacteria implicated in stomach ulcers and cancers.

Antiplatelet effects

Nagel and Oates (2007) cite studies to show that 6-MITC from Wasabi has been found to inhibit platelet aggregation in the elderly, where preventing excessive clotting is vital, by a number of different mechanisms, including the inhibition of lipoxygenase, cyclooxygenase and cGMP phosphodiesterase.

Anticancer effects

Wasabi ITCs inhibit the phase I enzymes, responsible for the conversion of precarcinogenic compounds to turn into carcinogenic compounds. These isothiocyanates can also induce detoxifying phase II enzymes like glutathione-S-transferase. 6-MITC has also been shown to block the cell cycle of cancerous cells and to affect protein production in cancerous cells.

Metastasis, a critical stage in spreading cancer beyond the local site, can be blocked by ITCs and, in particular, 6-MITC. Fuke and her co-workers (2000, 2006) and Manesh and Kuttan (2003) have shown that 6-MITC from *Wasabi* suppressed dissemination or metastasis of certain tumour cells. ITCs from *Wasabi* have been shown to cause cancerous cells to undergo apoptosis or cell death. This has been shown in leukaemia cells (Fimognari *et al.*, 2005), breast cancer cells (Nomura *et al.*, 2005), lung cancer (Kuang and Chen, 2004), colorectal cancer (Lund *et al.*, 2001) and cancerous cells of other types (Watanabe *et al.*, 2003; Fimognari *et al.*, 2005). *Wasabi* ITCs inhibit only cancerous cells and not healthy cells, and there are no reported side-effects (Nagel and Oates, 2007).

Other health effects

Wasabi and its isothiocyanates also have the following medical effects (Nagel and Oates (2007):

- reduce diarrhea;
- protect nephrons in diabetes patients;
- act as antioxidants;
- provide immune modulation;
- protect cardiovascular function.

28.8.3 Preparation of wasabi paste

In traditional Japanese cuisine, wasabi is prepared by grating the fresh rhizome against a rough surface, such as a ginger grater. From ancient times, the most preferred grating surface had been shark skin ('*oroshi*'), and this is still regarded as the preferred method of obtaining the best flavour, texture and consistency in freshly ground wasabi. In order to minimize the loss of volatiles, the rhizome is kept at a 90° angle to the grating surface; in this way, the volatile compounds are allowed to develop with minimal dissipation. Commercially wasabi paste is prepared using mincers to finely grind the rhizomes and then it is mixed with other ingredients depending on the end use of the paste (Savage, 2012).

28.8.4 Culinary uses

Sultana and Savage (2008) provide a useful overview of the use of *Wasabi* in cooking:

Wasabi adds a unique flavour, heat and greenish color to foods and, thus, it is a highly valued plant in Japanese cuisine. Wasabi is described as having 'a sharp hot taste with pungent smell', but the heat component in wasabi is different from chillies, and the

hotness quickly dissipates in the mouth, leaving an extremely pleasant mild vegetable taste, with no burning sensation at all. Wasabi adds aesthetic and culinary appeal to many foods and is considered a staple condiment in the Japanese diet. Recently, it has found widespread appeal in western cuisine due to its ability to change an ordinary dish to an extra special one by improving the taste (with addition of a spicy flavour). As a result, it is fast becoming a new flavour for the rest of the world. All the plant parts of wasabi possess same flavour but vary in the sharpness they deliver' and are, therefore, used for different purposes. Basically, wasabi can be served in three ways. These are as a condiment on the side of a dish, as a spice or herb in a dish and as wasabi flavour in processed foods. Rhizomes are the most popular tissues used to prepare fresh paste to be placed in a mound on a dish next to sliced raw fish (sashimi), spread on the raw fish in sushi preparations, or served on a small dish to accompany a bowl of cooked noodles. Sometimes grated wasabi is mixed with other ingredients like soya sauce and vinegar to prepare a dip for use with raw fish or other dishes, according to individual's choice. Tofu (soybean curd) is often decorated with grated wasabi. Wasabi petioles and leaves are pickled in sake brine or soya sauce and are popular accompaniments for white rice. Sometimes fresh leaves are used in salads and dried leaves are used to flavour cheese, salad dressings or crackers. A wasabi wine is sold (mainly as a novelty) in some Japanese specialty stores, as well as a high alcohol content wasabi liqueur.

28.8.5 Wasabi dishes

Wasabi is used in a variety of recipes in Japan and in the west (Anon., 2011d). A selection of dishes in which wasabi is used as a spices or condiment is provided below. The World of Wasabi website is a particularly useful source of wasabi recipes.

- **Dips, condiments and dressings:** Soy wasabi mayonnaise, wasabi soy sauce, avocado wasabi cream, wasabi maple dip, wasabi oil, wasabi ginger dressing, wasabi sesame dip, wasabi coconut dip, wasabi sandwich spread, cucumber wasabi sauce, wasabi butter, wasabi lime dressing.
- **Meat recipes:** Wasabi flank steak with mizo glazed potatoes, lamb shanks with wasabi, corned silverside with wasabi sauce, wasabi chicken wings, rabbit fillets with wasabi, coconut crusted chicken with wasabi sauce, wasabi lime steak, wasabi beef salad, wasabi meatballs, duck with orange wasabi glaze, meat loaves with wasabi garlic mash.
- **Fish recipes:** Tuna and ginger burgers, wasabi salmon and rice salad, sesame crusted tuna steaks, marinated sea bass, mini salmon wasabi rounds, wasabi goat cheese stuffed salmon, wasabi fish cakes, peppercorn crusted salmon with wasabi soy drizzle, crispy halibut with wasabi panzanella, tempura trout roll with caramelized onions and spinach, grilled Pacific salmon with soy-wasabi sauce and pickled ginger, tuna with wasabi cream.
- **Seafood recipes (excluding sushi):** Crab cake salad with wasabi vinaigrette, prawn mousse filled zucchini flowers tempura, tempura king prawns, crabmeat and wasabi vol au vents, wasabi and shrimp cheese rolls, barbecue oysters with wasabi mayonnaise, wasabi prawns, wasabi crab waffles, warm wasabi seafood salad, shrimp with wasabi ponzu butter sauce.
- **Sushi recipes:** Sushi is the most famous Japanese dish outside Japan, and one of the most popular dishes among the Japanese themselves. In Japan, sushi is usually enjoyed on special occasions. The basic ingredients of sushi are sushi rice, sushi

vinegar and various types of sea food items. The fish used in sushi is raw and safety guidelines have been evolved in order to avoid toxicity issues. The original use for wasabi was with Sashimi only. Sushi recipes include: smoked salmon and cucumber sushi rolls, California nori roll, avocado and crab meat sushi roll, kappa maki (cucumber roll sushi), tuna sushi, pickled daikon sushi, sushi shrimp, sorba noodle sushi, shiitake tofu rolls, sweet brown rice sushi, lamb sushi roll, California maki, cucumber and avocado sushi, egg and pesto sushi, inside out sushi roll, boat sushi (Gunkan-maki).

- **Vegetarian wasabi recipes:** Cold avocado wasabi-soup, hot potato salad, wasabi pickled cucumber, wasabi tomato salad, rice salad with wasabi dressing, wasabi tofu soup, tempura wasabi crisps, wasabi mango rice, wasabi stuffed potatoes, Japanese wasabi snack bars, wasabi crusted tofu, wasabi ginger popcorn, wasabi flavoured spinach, wasabi roasted asparagus, wasabi pea soup, wasabi almonds, wasabi potato fritters.
- **Desserts, cakes and cookies:** Wasabi cookies, wasabi muffins, wasabi cheesecake, pumpkin and wasabi pie, wasabi chocolate shortbread, wasabi fresh fruit compote, wasabi apple crumble, white chocolate wasabi praline, hot wasabi chocolate drink, frozen wasabi icecream pudding.
- **Drinks:** Namida gimlet, namida and tonic, namida samurai, namida martini, namida vesper, namida mary, namida Caesar, angry red planet, wasabi margarita, bloody samurai, bloody samurai's revenge.

28.8.6 Adulteration issues

Wasabi is one of the rarest spices in common use, and thus the availability of genuine wasabi is very limited. Horseradish is used in most of the products currently on the market, and up to 99 % of 'wasabi' being sold around the world is only coloured European horseradish (*Armoracia rusticana*) (Anon., 2009). This means that the valuable medicinal properties of wasabi do not reach consumers. This adulteration and substitution of genuine wasabi with horseradish has been going on for over six decades and seems likely to continue unless stringent measures are employed to prevent it (Anon., 2009).

In 2009, an organization known as the 'World Wasabi Council' (WWC) was formed by wasabi growers and manufacturers with the purpose of addressing this problem. Any genuine products should carry an 'Authentic Wasabi' logo prominently displayed for easy recognition by consumers. The WWC carry out independent scientific tests to verify that products carrying this logo do not contain any European horseradish and/or artificial colourings.

28.9 Less well-known spices and herbs

In addition to the herbs and spices discussed briefly in this chapter as well in Chapter 27, there are many more with restricted distribution and use. Such herbs and spices are used by certain communities in certain regions only and they may be of little commercial importance at the current time. However, these spices and herbs are very useful in the context of the innovations being attempted by the chefs around

the world, who are always in search of novel flavours and tastes to create new dishes having exotic appeal and taste. Some such herbs and spices are listed below.

28.9.1 Blue fenugreek

Blue fenugreek (*Trigonella coerulea* [Desr.ex Lam] Ser.) is also known as blue trigonella, blue–white clover, curd herb and blue melilot. This is a rare culinary herb found in the Alpine region, Western Europe and in the Europe–Asia border regions, and is seldom used outside these areas. The whole plant or dried seeds (sometimes the whole pods) are widely used as flavouring agents in breads, cheeses (such as sapsago and schabziger), stews and in other recipes in these regions. Blue fenugreek can also intensify other flavours. It forms part of the national herb–salt mixture of Georgia (called *khmeli suneli*), used as a seasoning for many meat and vegetable dishes. It is the most commonly used spice in rye bread made in the alpine regions, to which it imparts a unique flavour. For this purpose, the herb is harvested and subjected to a fermentation process as a result of which it acquires a very strong unique aroma (Katzer, 2008).

28.9.2 Boldo leaves

Boldo leaves (*Peumus boldus* Molina; Syn. *Boldu boldus*, *Boldea fragrans*; Monimiaceae) are known and used only in South America. Boldo leaves are strongly aromatic, similar to cinnamon or bay leaves and, when used, impart a very agreeable aroma to dishes. They are most useful in fish dishes, and can also enrich the taste and flavour of sauces, mushroom dishes, pickled vegetables and gravies. Boldo leaves contain about 2% essential oil, which contributes to the flavour and aroma of this leaf. The main component of the essential oil is ascaridol, a monoterpene peroxide with a disagreeable smell and found only very rarely in plants. The flavour-contributing compounds are *p*-cymene, 1,8-cineol and linalool. The leaves also contain alkaloids such as boldine, isoboldine and *N*-methyllaurotetanine. They are used in herbal teas, and were part of traditional Mayan medicine. Research has verified the various indigenous uses of boldo leaves: in animal studies, they have been shown to stimulate digestion and to have anti-inflammatory, antioxidant and bile-producing and diuretic properties which are attributed largely to the plant chemical boldine. A US monograph reports that boldo can increase urine output by 50%, which again validates the plant's traditional use as a diuretic (Taylor, 2004; Katzer, 1998a). An ethanol extract of the leaf administered to mice was shown to have a liver protective effect, preventing damage from chemical exposure. The extract also relaxes smooth muscle tissue and prolongs intestinal transit.

28.9.3 Chameleon plant

Chameleon plant (*Houttuynia cordata* Thunb.; Chinese lizard plant, fish wort, heart leaf; Saururaceae) is a native of the South East Asian region. There are two distinct types differing in flavour: the Chinese variety, native to China and Vietnam, has a strong coriander-like aroma and resembles Vietnamese coriander (*Eryngium foetidum*); the Japanese variety has a lemony and ginger-like aroma, and is distributed

in an area from Nepal to the Korea region, extending to Japan. In these regions, the leaves of this plant are used in a variety of local dishes, especially in salads and fish recipes. In Japan, it is also used as a fresh leaf garnish for soups, salads and sushi dishes. In China, its roots are used as a vegetable. The major flavour-contributing components are myrcene and 2-undecanone. It is a medical plant with a proven anti-inflammatory effect and has been found to be useful in combating severe acute respiratory syndrome (SARS) (Lau *et al.*, 2008; Katzer, 2012b).

28.9.4 Cicely

Cicely (*Myrrhis odorata* [L.] Scop.; sweet cicely, anise cicely, garden myrrh, sweet scented myrrh; Apiaceae) is one of the very few aromatic culinary herbs found in the very cold climates of the Scandinavian region, and is distributed over an area extending as far north as Iceland. Cicely has a sweet aromatic taste; its fruits are a good substitute for anise or fennel, while the leaves impart an aroma and flavour similar to that of chervil, but significantly stronger. The plant contains volatile oil, the components of which are *trans*-anethole, germacrene-*D*, β -caryophyllene, limonene, chavicol methyl ether, α -pinene, α -farnesene and myrcene. It also contains flavonoids such as luteolin and apigenin glucosides. Cicely leaves contain an essential oil with anethol as the predominant component. Cicely is used principally in fish recipes. The fresh leaves can be used in salads and chopped leaves are used in dishes along with rhubarb, gooseberries and other fruits. Cicely leaves are also used in fruit salads and drinks. The roots can be eaten as a vegetable, and can also be candied. The seeds can be used in cakes and candy, while the dried leaves are used in herbal tea (Katzer, 2000b; Hyde, 2011).

28.9.5 Cresses

There are many herbaceous plants known by the common name cress; however, the most common are garden cress (*Lepidium sativum* L., Brassicaceae), water cress (*Nasturtium officinale* L., Brassicaceae) and nasturtium (*Tropaeolum majus* L. Tropeolaceae). Garden cress and water cress belong to the mustard family (Brassicaceae), and nasturtium belongs to the Tropeolaceae family. All three types of cress have similar flavour qualities and are used in similar ways. Cresses have a spicy aroma and a refreshing peppery, pungent taste. The unique taste and flavour are due to the presence of isothiocyanate derivatives, which are characteristic of plants in the mustard family. The main component of water and garden cresses is gluconasturin, which yields 2-phenylethyl-isothiocyanate. Nasturtium leaves contain glucotropaeolin, which on hydrolysis gives benzyl-isothiocyanate. Cresses must be used fresh: they cannot be dried because drying removes the flavour almost completely. Cresses are used in local traditional medicine as a remedy for cough, cold, asthma, diabetes, anaemia, constipation and also as a body deodorizer. They are also a good source of iodine (Shipard, 2003). All three cresses are very commonly used in European and American cuisines. In America, they are used for spreads (especially based on cheese) and salads and often served along with bread and butter. Chopped cress leaves are used as toppings on warm dishes like vegetable soups, scrambled eggs and fish dishes. In Europe, cress leaves are used in flavouring

vinegar, sauces and soups, particularly in the form of a herb mixture known as mustard cress. This is a mixture of mustard and garden cress seedlings grown together for use (Katzner, 2012c). The BBC cook book lists 107 recipes using cresses. (Anon., 2011c).

28.9.6 Epazote

Epazote (*Chenopodium ambrosioides* L.; wormseed, Mexican tea; Chenopodiaceae) is a Mexican aromatic herb with a strong aroma and is characteristically used in the Mayan cuisines of Mexico and Guatemala, being relatively unknown outside Central America. All aerial plant parts of this herb contain essential oil (0.7 % in the leaves, 2.5 % in the unripe fruits), which is composed of various monoterpenoids (α -pinene, α -phellandrene, thymol, myrcene, *p*-cymene, terpinene, campher, *trans*-isocarveol) and ascaridole, a monoterpene peroxide (Katzner, 2000c; Stuart, 2003). Its essential oil and its infusion are anthelmintic; the oil is active against intestinal nematodes, and aqueous extract is active against plant nematodes. Methanol extracts are anti-inflammatory and analgesic and ethanol extracts are used to reduce tumour growth, most likely due to an immunomodulatory effect. Tea made from its dried leaves is patented as a treatment for uterine fibroids (Diroff, 2008). Diroff (2008) has provided a detailed review on all aspects of epazote, including its medicinal properties and, biological actions. The herb is used fresh in soups, salads, meat dishes, sauces and, most commonly, in bean dishes (such as the famous Mexican refried beans). It is also used in Mexico as herbal tea. The www.food.com site lists 79 recipes using epazote (Anon., 2011d).

28.9.7 Finger root

Finger root (*Boesenbergia pandurata* (Roxb.) Schltr.; Chinese ginger; ginger family–Zingiberaceae) is a commonly used spice in Thai cuisine. It is less popular in China, Vietnam, Cambodia and Indonesia. It is a rhizomatous herb; the rhizomes develop like the fingers of a hand, have a strong flavour and are best used fresh. The rhizome contains 1–3 % essential oil, the important components of which are 1,8-cineol, camphor, *d*-borneol and methylcinnamate. Li Ching (2008) reported the presence of eucalyptol, camphor, α -citral, β -citral, β -linalool and methyl cinnamate. Geraniol was also reported in the hydrodistilled oil. The solvent extract of finger root was reported to have antibacterial properties. Cell line screening using HL-60 cancer cell line indicated that the extract also has an anticancer effect, with a compound called bossenbergin A, reported to have the strongest cytotoxic effect. Finger root is used mainly in fish curries, vegetable stews and sea food soups (Katzner, 2003a). Grated rhizomes of finger root are also used in recipes for pork fried rice, roast pork, dishes containing broccoli, cheese and chicken, and in dishes like almond crusted chicken tender salad, apricot ginger teriyaki, garlic chilli pepper wings, roasted soy Dijon lamb racks, among others.

28.9.8 Gale

Gale leaves (*Myrica gale* L.; sweet gale, candleberry, bog myrtle; Myricaceae) are used for flavouring dishes in Europe and America. The plant is found in northern

Europe, West Asia and the USA. Gale leaves are aromatic, and can be used either fresh or dried, the aroma intensifying after drying. The leaf contains essential oil, the main components of which are α -pinene, 1,8-cineol, myrcene and limonene. Gale leaves are used like bay and cinnamon leaves: the whole leaf should be steeped in the dish during preparation, and the leaves are removed before serving. Gale leaves impart a very agreeable and pleasant flavour to boiled vegetable stews and legume dishes, but are less commonly used in meat dishes. Historically, the most important use of gale leaf has been for flavouring beer. In the Scandinavian countries, gale leaves are also used to flavour schnapps (a type of distilled alcoholic beverage) (Katzner, 2003b ; Anon., 2011e)

28.9.9 Lemon myrtle

The original home of lemon myrtle (*Backhousia citriodora*; sweet verbena tree, lemon scented myrtle, lemon ironwood; myrtle family–Myrtaceae) is Queensland and the Australian mainland. The leaf of this small tree has an intense, refreshing, lemon-like aroma and warm pleasant taste.

The leaves contain about 4–5 % essential oil, and two chemotypes can be identified based on the predominant component in the essential oil. In one, the predominant component is citral (citral type) and in the other, the main component is citronellal (citronellal type). The former is more common and is the one used for culinary purposes. It is often described as the queen of lemon herbs, because its essential oil contains around 95–97 % citrals, in contrast to lemon peel, which contains only up to 10 % citrals. The oil of lemon myrtle is antifungal, antiseptic, antiviral, calmative and sedative. Its fragrance, together with its medicinal properties, makes it ideal for use in cosmetics, toiletries, incense burners and massage oils. Citral is used extensively as a food flavouring, but a leaf or two of lemon myrtle is a good substitute. Lemon myrtle is used in cooking and it blends well with macadamia nut oil. The leaves are used fresh, dry, as powder or as encapsulated extracted flavour. It is used widely in a variety of food products from bread to pasta, in fish preparations, as a herbal tea, in milk-based products, creams, cheesecakes; and also in native beer. Lemon myrtle is also a widely grown ornamental and avenue tree (Katzner, 1999).

28.9.10 Mexican pepper leaf

Mexican pepper (*Piper auritum* Kunth; hoja santa, yerba santa, anisello, rootbeer plant; sacred pepper leaf; black pepper family–Piperaceae) is a member of the black pepper family with large fleshy leaves. It is known as *hoja santa* in Mexico, which means sacred leaf. Mexican pepper leaf and its young stems are widely used to flavour various dishes in Mexican cuisine; outside Mexico it is seldom used mainly due to a lack of availability. Both fresh and dried leaves are used; they have a pleasant aroma, somewhat akin to anise, nutmeg and black pepper. The young stems have a stronger flavour, which is also warm and mildly pungent. Safrole is the major component of the Mexican pepper leaf; minor components include α -pinene, camphene, sabinene, β -pinene, myrcene and α -phellandrene (Gupta *et al.*, 1985). Mexican pepper leaf is also used medicinally by the local people in Mexico. It is said to help relieve nervous anxiety, stress and restlessness. It can be eaten or taken as a tea;

however, it is very powerful and should be used on a limited basis. Long-term use may cause liver problems.

Mexican pepper leaf is widely used for tamales, being wrapped around fish, meat steaks and chicken before steaming, baking or grilling. The famous Mexican dish *pescado en hoja santa* is fish wrapped in Mexican pepper leaves baked and served with a spicy tomato sauce. Unlike other wrappers, the Mexican pepper leaf wrapper is eaten along with the fish or meat. In central Mexico, pepper leaves are used for flavouring chocolate drinks (the famous Aztec chocolate). It is an important ingredient in *mole verde*, the famous Mexican sauce. An American cheese brand, *hoja santa* cheese, is goat's milk cheese wrapped in Mexican pepper leaves. The leaves are often gently fried in oil before being used to flavour salads, sauces and various other dishes (Katzner, 2012a).

28.9.11 Tasmanian pepper

Mountain pepper or Tasmanian pepper (*Tasmania lanceolata* L.; Mountain pepper, Australian pepper tree; Winteraceae) is native to Australia (New South Wales), and plays an important role in Australian cuisine. For cooking, the dried berries and dried powdered leaf are used; both have a strong woody fragrance, with a black pepper-like taste with a cinnamon-like notes. Tasmanian pepper is initially intensely hot and pungent, so caution is required in its use. It then produces a strange sensation of numbness similar to the effect of Szechuan pepper. The component responsible for this pungency is polygodial, which is a dialdehyde with a bicyclic sesquiterpenoid skeleton. Tasmanian pepper goes well with other aromatic herbs and can be mixed with other spices like coriander, lemon myrtle, wattle seed and salt. In Australia, it is essential for preparing bush food dishes, like emu burgers, kangaroo steaks and so on. The berries are crushed and mixed with oil, and the resulting product is used for marinating meat. The berries are used in flavoured breads, pastas and patés, mustards and cheeses. In stews or sauces this spice imparts a vibrant red colour which can be very attractive. Tasmanian pepper is now being marketed internationally and is available in many western supermarkets. Dishes using Tasmanian pepper include: salmon with acacia seed and Tasmanian pepper berries, Australasian roast pork, Australasian roast chicken, balmian bugs and whiting, and Tasmanian pepper beef stew (Katzner, 2001a).

28.9.12 Water pepper

Water pepper (*Polygonum hydropiper* L.; marsh pepper; Polygonaceae) grows in wet environments in temperate to tropical Eurasia, North Africa and North America. Young shoots form the useful part. This plant has no smell but a very pungent taste and, like Tasmanian pepper, produces numbness in the tongue and mouth. The leaf contains essential oil, the main components of which are α -pinene, β -pinene, 1,4-cineol, fenchone, α -humulene, β -caryophyllene and *trans*- β -bergamotene. As with Tasmanian pepper, the bicyclic sesquiterpenoid, polygodial, has been found to be responsible for the pungent taste. The pungency imparted by the water pepper is such that it is difficult to substitute it with any other spice. However, the use of water pepper is restricted to Japanese cooking and to the cuisine of some areas of South

East Asia such as Vietnam. In Japanese cookery, water pepper leaf is widely used in soups, salads, and also for garnishing sushi. Since water pepper does not have a taste or flavour of its own except pungency, it is used in Japanese cuisine wherever pungency is required without masking the original flavour and taste of a dish and its ingredients, such as in fish recipes and sushi. Certain types of water pepper have very low pungency, and these are used in Japan as a vegetable. Water pepper seeds are also very pungent, and were used once as a substitute for black pepper, but are rarely used today (Katzer, 2000d).

28.10 References

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