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Review

Pharmacological properties and their medicinal uses of *Cinnamomum*: a review

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Abstract

Objectives *Cinnamomum* (Family Lauraceae) is traditionally used for flavouring food and in pharmaceutical preparations against various ailments. Detailed literature on the ethnobotanical and pharmacological properties of *Cinnamomum* is segregated and not present in well-documented form. In the present review, we have been trying to gather its detailed medicinal as well as pharmacological properties. The ethnobotanical and pharmacological properties of *Cinnamomum* were collected by searching several scientific databases, that is PubMed, Elsevier, Google Scholar, Science Direct and Scopus.

Key findings The plant extracts have been reported to possess astringent, warming stimulant, carminative, blood purifier, digestive, antiseptic, antifungal, antiviral, antibacterial, antioxidant, anti-inflammatory and immunomodulatory properties and also help to reduce cholesterol and blood sugar levels. A wide range of phytochemical compounds including aldehydes, acetate, alcohol, terpinenes, flavonoids, alkaloids, anthraquinones, coumarins, phenols, saponins, tannins, carboxylic acid, hydrocarbons, camphene, spathulenol, fatty acids, actinodaphnine, butanolides, lignans, steroids, propenoids and kaempferol glycosides are found in various parts of plant.

Summary This review provides detailed information about history, traditional uses, phytochemistry and clinical impacts of cinnamon as a spice and medicine. So we recommend further study on the clinical, medicinal, purification and identification of the most effective antibacterial activity of cinnamon to cure various infectious diseases.

Introduction

Cinnamomum derived from the Greek word 'kinnamomon' which means 'spice'[1] and 'sweet wood'.[2] Around 250 species of this genus are identified around the world.[3,4] Different parts contain some primary constituents, that is cinnamaldehyde and trans-cinnamaldehyde (Cin), present in the essential oil of its bark contributing to the fragrance and various biological activity,[5] eugenol (leaf) inhibit several different MDR pathogenic bacteria[6,7] and camphor (root).[8] This genus contains four main economically important cinnamon species, that is *Cinnamomum verum* ('true cinnamon', Sri Lankan or Ceylon cinnamon), *Cinnamomum cassia* (Chinese cinnamon), *Cinnamomum burmannii* (Java or Indonesian cinnamon) and *Cinnamomum loureiroi* (Vietnamese or Saigon cinnamon).[9] Cinnamon have immense aromatic potential are used in food and pharmaceutical industry. Its leaf and bark have digestive, blood purifier, astringent, carminative, warming stimulant, antiseptic, antibacterial, antifungal and antiviral properties and can help to reduce cholesterol and blood sugar levels. Camphor is one of the important chemical compounds derived from *C. camphora*, employed in pharmaceuticals, especially liniments and insecticides.[2] Its bark contains procyanidins and catechins[10] which is used as spices for cooking as well as very useful to cure type 2 diabetes mellitus[11–13] and insulin resistance medicine.

Table 1 summarizes the chemical constituents, pharmacological activity and medicinal properties of various *Cinnamomum* species.

Materials and Methods

The current review was conducted using a complete and organized search of the available literature. The searches were performed using various databases, including PubMed (http://www.ncbi.nlm.nih.gov/pubmed), Science Direct (http://www.sciencedirect.com/), Scopus (http://www.scopus.com/), Scirus (http://www.scirus.com/) and Google Scholar (http://www.scholar.google.com/) using the terms, for example *Cinnamomum* spp., phytochemistry, pharmacological activity, cinnamon, antibacterial antimicrobial and traditional uses. Scientific names and synonyms were validated through www.theplantlist.org and www.tropicos.org.

History

Cinnamon is used in different culinary practice from thousands of years.[14] Due to its high healing significance, it has been used as antiemetic, antidiarrhoeal, antiflatulent and stimulant agent in Ayurvedic medicine.[15] Egyptian people used it for mummification.[16] Portuguese imported the spice (*C. zeylanicum*) from Sri Lanka to European countries during the 16th and 17th centuries.[14] In Java, cinnamon cultivation started in the 17th century during the Dutch occupation, and it exported by East India Company to European countries.[16] Sri Lanka became the main source of cinnamon oils after Ceylon cinnamon cultivation reduces, which is used in pharmaceutical and food industries. Chinese cinnamon oil is also used by pharmaceutical industries.[16]

Distribution

This genus was described by Schaeffer, Jacob Christian (H. von) Schaeffer, in the year 1760. About 250 species of *Cinnamomum* are found in the tropical and subtropical regions, frequently in Asia and some in South and Central America and Australia.[17]

Botanical description

This genus contains small, evergreen trees and shrubs of 10–15 m tall. Plants are found in China, Australia, South-East Asia and Africa. The leaves are ovate–oblong and 7–18 cm long.[18] Flowers are greenish in colour and arranged in panicles. The fruit is a 1-cm purple berry with a single seed.[19,20] It grows in tropical rain forests at various altitudes from highland slopes to lowland forests including marshy places and on well-drained soils. However, they become extremely rare in latitudes with seasonal climatic conditions.[18,20]

Traditional uses

Its timber is used for decoration, furniture, cabinet and plywood manufacture. *C. javanicum* have tough timber used for construction and house building. The term cinnamon is the dried bark of *C. zeylanicum* and *C. aromaticum*[21] used in preparing chocolate, beverages, spicy candies and liquors.[22] True cinnamon obtained from *C. verum* bark which is one of the most required spice.[23] Several species are also used as substitutes for the true cinnamon. The four main commercially available cassias are *C. cassia*, *C. tamala*, *C. burmannii* and *C. loureirii*. *C. burmannii*, *C. iners*, *C. porrectum*, *C. rhynchophyllum* and *C. soegengii* are used as spice and flavouring food in Sabah. Java cinnamon (*C. burmannii*) which is also known as 'keningau' is commonly found in the foothills of the Crocker Range and Keningau. As an ingredient, distilled cinnamon oils are also used in flavouring foods and drinks. Diarrhoea and malaria can be cure by the bark of *C. burmanii*.[24] *C. politum* bark is mixed with hot drinks to give strength and relieve muscle pain. Crushed leaves and bark paste of *C. crassinervium* are used for headache. *C. rhynchophyllum* and *C. soegengii* leaves are used to treat stomach ache and food poisoning.[24] In Peninsular Malaysia, leaf juice of *C. iners* is used as a poultice by the Sakai ethnic group for rheumatism. *C. javanicum* root decoction is used to treat fatigue and chest pain, while *C. crassinervium* is used for stomach ache. The roots of *C. iners*, *C. porrectum* and *C. subcuneatum* are boiled, and its decoction is given after childbirth and also for treating fever. The roots of *C. subcuneatum* are used in pain relief on rheumatic joints. *C. porrectum* seed oil can also be used for rheumatism. The bark and fruits are also used in perfumes. *C. porrectum* used as a scent for soap and *C. verum* as perfumes. The mucilage of *C. iners* is used in the manufacture of mosquito coils, fragrant joss sticks and formica.[25] Cinnamon possesses strong antifungal, antibacterial, antitermitic, larvicidal, nematicidal, and insecticidal properties.[26–31]

Clinical aspects

Several clinical studies on cinnamon are conducted due to its high remedial potential. According to Clinical Trials Govt. database, a total of 26 clinical trials including six studies, 14 completed studies, two recruited studies, two terminated studies and two active studies have been done. However, most of these studies still under process (Table 2).[32]

Table 1 The chemical constituents, antimicrobial activity and medicinal properties of various *Cinnamomum* species

S. No.	Plant	Part used	Chemical constituent	Pharmacological activity	Medicinal use
1.	*Cinnamomum aureofulvum* Gamble	Leaf	*Aldehydes*: (E)-Cinnamaldehyde, benzaldehyde.[38] *Acetate*: (E)-Cinnamyl acetate, benzyl acetate.[38] *Alcohol*: Benzyl alcohol.[38] *Terpinenes*: (Z,Z)-Farnesol, 1,8-cineole, borneol, guaiol, myrcene, terpinen-4-ol, β-caryophyllene, γ-terpinene, α-guaiene, α-terpineol[38]	Antimicrobial activity,[38] platelet-activating factor (PAF) receptor-binding antagonist activity[39]	Headache[38]
		Bark	*Acetate*: (E)-Cinnamyl acetate, benzyl acetate.[38] *Aldehydes*: (E)-Cinnamaldehyde, benzaldehyde.[38] *Terpinenes*: (Z,E)-Farnesol, (Z,Z)-farnesol, 1,8-cineole, borneol, camphene, guaiol, limonene, myrcene, p-cymene, terpinen-4-ol, terpinolene, zingiberene, β-bisabolene, β-caryophyllene, β-fenchol, β-pinene, γ-terpinene, α-bisabolol, α-cadinol, α-phellandrene, α-pinene, α-terpinene, α-thujene[38]		
2.	*Cinnamomum bejolghota* (Buch.-Ham.) Sweet	Leaves	*Acetate*: Linalyl acetate.[40] *Flavonoids*: Cinnamaldehyde.[41] *Terpinenes*: 1,8-Cineole, a-terpinol linalool, nerolidol, terpinen-4-ol, β-caryophyllene, β-phellandrene, δ-3-carene, α-farnesene, α-phellandrene, α-pinene[40]	Allergen-reduction activity,[42] anthelmintic activity,[43] antiacetylcholinesterase activity,[44] antidiabetic activity,[45,46] antimicrobial activity,[47–50] antioxidant activity[44,45,51,52]	Abdominal disorders,[53] body ache,[54] cholelithiasis,[55,56] cough and cold,[57] carminative, diarrhoea, dyspepsia,[58] flatulence,[54] food borne illness,[55] gall stone,[53] gynaecological complexity,[48,54] hepatomegaly,[59] hepatitis,[60] headache,[53] influenza,[57] liver complaints,[61,62] malaria,[59] nausea,[58] oral problems,[40] ostalgia,[48] pyrexia,[40] rheumatoid arthritis,[54] skin disease,[53] stomach pain,[63] tooth ache,[55] ulcer,[48] urogenital diseases,[40,55,56] wounds[53,64]
		Bark	*Acetate*: Dihydrocarveol acetate, dihydrolinalool acetate, isobornyl acetate, Z-α-trans-bergamotol acetate, α-bisabolol acetate.[65] *Aldehyde*: Hexanal, tetradecanal,[66] E-2-hexyl cinnamaldehyde, limonene aldehyde, Z-cinnamaldehyde.[65] *Alcohol*: 1-Hexanol[20], α-amyl cinnamyl alcohol.[65] *Terpinene*: 1,8-Cineole, α-pinene, linalool, α-terpinene, α-thujene, γ-terpinene, ρ-cymene.[65,66] (Z)-β-ocimene, (E)-nerolidol, (E)-β-ocimene, camphene, cis-piperitol, endo-fenchol (α-fenchol), geraniol, geranyl acetate, germacrene-D, limonene, nerol, neryl acetate, myrcene, sabinene, spathulenol, terpinen-4-ol, terpinolene, trans-β-terpineol, trans-piperitol, β-caryophyllene, β-elemene, β-pinene, β-selinene, δ-cadinol, δ-guaiene (α-bulnesene), α-cadinol, α-humulene, α-panasinsene, α-phellandrene, α-selinene, α-terpineol.[66] 13-epi-manoyl oxide, 3Z-cembrene A, 7-epi-α-selinene, borneol, camphor, E-β-ocimene, epi-α-cadinol, guaiol, isoborneol, myrcene, phytol, pinene, sabinene, sclareolide, terpinen-4-ol, Z, E-geranyl linalool, α-humulene, α-trans-bergamotene, α-zingiberene, γ-terpineol, δ-3-carene, ρ-mentha-2,4 (8)-diene[65]		
		Flower	*Aldehyde*: α-Campholenal.[66] *Acetate*: Cis-pinocarvyl acetate.[66] *Alcohol*: α-Caryophyllene alcohol.[66] *Terpinen*: (Z)-β-Ocimene, (E)-nerolidol, (E)-β-ocimene, (E,E)-farnesol, 1,8-cineole, borneol, camphene, carvone, endo-fenchol (α-fenchol), linalool, limonene, p-cymene, myrcene, terpinen-4-ol, trans-carveol, trans-verbenol, tricyclene, verbenone, β-caryophyllene, β-elemene, β-pinene, β-selinene, δ-cadinol, δ-selinene, α-humulene, α-panasinsene, α-pinene, α-selinene, α-terpineol, α-thujene[66]		

Table 1 (*Continued*)

S. No.	Plant	Part used	Chemical constituent	Pharmacological activity	Medicinal use
3.	*Cinnamomum burmannii* (Nees & T. Nees) Blume	Leaf	*Alcohols*: Cyclohexane methanol.[67] *Aldehydes*: Trans-cinnamaldehyde.[68] *Acetate*: Trans-cinnamyl acetate; bornyl acetate[68]; acetate; bornyl acetate.[67] *Terpinenes*: (−)-Spathulenol; caryophyllene; D-borneol; eucalyptol; guaiol[67,68]	Anticancer activity,[69,70] antidiabetic activity,[71] anti-inflammatory activity,[72,73] antimicrobial activity,[74,75] antioxidant activity,[71,73,76] antipyretic activity,[77] cytotoxicity,[73] gene expression and immune response activity,[78,79] gastroprotective activity,[80] hepatoprotective activity,[81] immunomodulatory activity,[82] neuroprotective activity,[83] ultraviolet (UV) protective activity/sun protection activity,[84] wound healing activity,[85] toxicological studies,[86,87] antidiabetic activity[71]	Arthralgia,[68] arthritis,[88,89] bellyache,[88] chest complaints,[68] colic,[89] cough & cold,[88,89] diarrhoea,[89] diabetes,[68] dyspepsia,[68,89] dysuria,[88] flatulent,[68,89] gripe,[68] influenza,[89] malaria,[68] nausea,[68,89] pains,[68] periodontal disease,[68] pyrexia,[88,89] puerperium,[88] respiratory tract problems,[90] rheumatic arthritis,[68,89] rheumatic arthralgia,[68] rhinitis,[88] soft tissue contusion,[68] sprain,[68] traumatic injury,[68] traumatic haemorrhage[68]
		Fruit	*Flavonoid*: Anthocyanins, proanthocyanidins.[68] *Terpenes*: Camphene; caryophyllene; citral; elemene; fenchol; guaiene; linalool; myrcene; nerolidol; pinene; sylvestrene; terpineol.[68]		
		Shoot	*Terpenes*: Camphene; caryophyllene; citral; elemene; fenchol; guaiene; linalool; myrcene; nerolidol; pinene; sylvestrene; terpineol[68]		
		Plant peel	Amino acid: Melanin[68]		
4.	*Cinnamomum cambodianum* Lecomte	Bark	*Terpinenes*: 4-Terpineol, cadalene; isospathulenol; viridiflorol; α-cadinol; α-epi-cadinol; α-terpinene, α-terpinol, α-terpinolene, β-spathulenol; β-terpineol, γ-terpinene[91,92]	Antiallergic activity,[93] antimicrobial activity,[91] antioxidant activity,[92] cytotoxicity,[91] hepatoprotective activity[94]	Gynaecological troubles,[95] indigestion,[96] liver complains,[95] menstrual pain,[96] sprains and injuries,[96] tuberculosis[96]
		Leaf	*Terpinenes*: (E)-β-Ocimene; (*E*)-β-santalol; camphene; *cis*-α-santalol; *epi*-α-bisabolol; spathulenol; germacrene B; isospathulenol; limonene; linalool oxide (pyranoid); *neo*-*allo*-ocimene; *o*-cymene; phytol; sabinene; terpinen-4-ol; trans-nerolidol; verbenone; α-bisabolol; α-pinene; α-terpinene; α-terpineol; α-thujene; β-myrcene; β-spathulenol; β-vetivenene; γ-terpinene; δ-3-carene.[91] *Terpenoids*: 1,8-Cineole; carvone; geraniol; guaiol; teresantalol; α-amorphene; α-phellandrene; α-santalene; γ-eudesmol[91]		
5.	*Cinnamomum caryophyllus* (Lour.) S. Moore		*Acetates*: Bornyl acetate; neryl acetate.[97] *Aldehydes*: (E)-Cinnamaldehyde.[97] *Terpenes*: (E)-Nerolidol; 1,8-cineole; 2,5-cyclohexadiene-1-one; borneol; camphene; camphor; carvacrol; ledol; linalool; methyl eugenol; myrtenal; piperitone; terpineol-4-ol; trans-carveol; trans-pinocarveol; tricyclene; verbenene; verbenone; β-caryophyllene; β-myrcene; β-pinene; ρ-cymene; ρ-cymenene; α-pinene; α-ylangene.[97]	Hepatoprotective activity[94]	Abdominal disorders, cholera and digestive stimulant[98]
6.	*Cinnamomum culilaban* (L.) J. Presl		*Carboxylic acid*: Asam propanoat (propionic acid).[99] *Hydrocarbons*: Naftalen (naphthalene).[99] *Terpinenes*: Sparthulenol (spathulenol); terpinol; timol (thymol); verbanol; verbenone[99]	Antimicrobial, antioxidant activity, toxicological studies[100]	Bone pain,[100] Cholera,[100,101] constipation,[101] gynaecological problems,[100] rheumatism [100]
7.	*Cinnamomum filipedicellatum* Kosterm.	Leaf	*Aldehyde*: Cuminaldehyde.[102]*Terpinenes*: Carvone; germacrene B; limonene; linalool; p-cymen-7-ol; p-cymene; piperitone; terpinen-1-ol; terpinen-4-ol; trans-carveol; α-terpineol[102]	Antimicrobial[102], hepatoprotective[103]	Urinary problems,[103] wounds[103]
		Bark	Anthraquinones, cardiotonic glycosides, cyanogenic glycosides, leucoanthocyanins, saponins, steroids, triterpenes[103]		

Table 1 (Continued)

S. No.	Plant	Part used	Chemical constituent	Pharmacological activity	Medicinal use
8.	*Cinnamomum glanduliferum* (Wall.) Meisn.	Leaf	*Acetate*: Bornyl acetate; neryl acetate.[104] *Terpinenes*: Caryophyllene oxide; limonene; p-cymene; sabinene; terpinen-4-ol; α-pinene[104–106]; camphene; cis-sabinene hydrate; β-pinene; γ-terpinene[104,105]; eucalyptol; germacrene B; germacrene-D; globulol; spathulenol; terpinolene; trans-caryophyllene; trans-sabinene hydrate; β-elemene; β-myrcene; δ-2-carene; α-humulene; α-thujene.[105] (E)-nerolidol; 1,8-cineole; carvone; cis-linalool oxide (furanoid); eugenol; geranial; linalool; myrcene; piperitone; thymol; trans-carveol; trans-linalool oxide (furanoid); trans-sabinene hydrate; β-selinene.[104] 1,8-cineole; carvacrol; elemicin; germacrene-D-4-ol; trans-ocimene; β-caryophyllene.[106] linalool; α-phellandrene; α-terpineol.[104,106] α-terpinene; α-thujene[104,105]	Anticancer,[107] anti-inflammatory,[105] antimicrobial,[107,108] cytotoxic,[109] gastroprotective,[105] larvicidal[110]	Abdominal disorders,[111,112] asthma,[112] bronchitis,[113] cough and cold,[114,115] diabetes,[63] dizziness,[106] dysentery,[114] dyspepsia,[112] gonorrhoea,[111] infestation,[63] head ache,[116] kidney trouble,[63] nausea,[116] oral,[40] pneumonia,[55,113] pyrexia,[55] respiratory problems,[112] rheumatism,[55] shivering,[116] snake bite,[112] tooth ache,[117] wounds[117]
		Stem	*Terpinenes*: Camphene; caryophyllene oxide; *Cis*-sabinene hydrate; eucalyptol; limonene; p-cymene; sabinene; terpinene-4-ol; terpinolene; trans-caryophyllene; trans-sabinene hydrate; β-myrcene; β-pinene; γ-terpinene; δ-2-carene; α-humulene; α-pinene; α-terpinene; α-terpineol; α-thujene[105]		
		Bark	*Terpinenes*: Borneol; camphene; camphor; cubenol; eucalyptol; fenchol; guaiol; isoborneol; limonene; p-cymene; sabinene; terpinen-4-ol; terpinolene; α-humulene; α-phellandrene; α-pinene; α-terpinene; α-terpineol; α-thujene; β-myrcene; β-pinene; γ-terpinene[107]		
9.	*Cinnamomum glaucescens* (Nees) Hand.-Mazz.	Leaf	*Acetate*: Geranyl acetate.[118] *Aldehyde*: Heptanal; hexanal.[104] *Terpinenes*: (E)-Nerolidol; limonene; linalool[104,118]; (E)-β-ocimene; (E, E)-α-farnesene; epi-β-santalene; safrole; β-pinene[104]; (Z)-citral; (Z)-β-ocimene; bicycloelemene; borneol; camphene; caryophyllene oxide; farnesol; geranila; geraniol; germacrene-D; O-cymene; sabinene; selina-4(15), 7(11)-diene; terpinen-1-ol; terpinen-4-ol; trans-sabinene hydrate; α-gurjunene; α-humulene; α-phellandrene; α-pinene; α-terpinene; α-terpineol; α-terpinolene; α-thujene; β-bisabolene; β-myrcene; β-selinene; γ-elemene; γ-terpinene; δ-cadinene[118]	Antimicrobial,[119,120] antioxidant,[119] cytotoxicity,[109,120] larvicidal,[117] nematicidal,[117] toxicological[119]	Arthritis,[119] blood circulation,[119] body aches,[117] boils,[63] bronchitis,[55,121] cough and cold,[122] eruption,[63] inflammation,[119] infestation,[117] kidney trouble,[63,117] muscles and joints complications,[119] muscular spasm,[117] myalgia,[119] pyrexia,[63] rheumatism,[119] toothache,[117,122] urinogenital diseases[40]
		Fruit and seed	Methyl cinnamate, thymol, safrole, cineole, eugenol, linalool, linalyl acetate and nerol; methyl cinnamate; 1,8 -cineole, α-terpineol[58]		
		Fruit and pericarp	*Terpinenes*: 1,8-Cineole; camphor; linalool; sabinene; β-pinene; α-terpineol; α-thujene[119,123]; (2)-β-ocimene; (E)-β-ocimene; camphene; carvacrol; caryophyllene oxide; geranial; geraniol; limonene; myrcene; p-cymen-8-ol; p-cymene; p-elemene; spathulenol; terpinen-4-ol; terpinolene; β-bisabolene; β-caryophyllene; β-phellandrene; β-selinene; γ-terpinene; δ-terpineol; α-bergamotene; α-cubebene; α-humulene; α-phellandrene; α-pinene; α-selinene; α-terpinene[117]; cis-ocimene; DL-limonene; thujene[119]		
		Root	*Acetate*: Neoiso-3-thujanol acetate.[122] *Aldehyde*: Benzaldehyde; cuminal.[122] *Terpinenes*: (2E,6E)-Farnesal; (2Z,6E)-farnesol; (E)-caryophyllene; 1,8-cineole; 1-epi-cubenol; 14-hydroxy-9-epi-(E)-caryophyllene; ascaridole; cadalene; camphene; carvone; caryophyllene oxide; cis-linalool oxide (furanoid); cis-linalool oxide (pyranoid); cubebol; epi-cubebol; geranial; geraniol; isoborneol; linalool; myrcene; neral; nerol; o-cymene; p-cymen-7-ol; p-cymene; piperitone; sabinene; spathulenol; terpinen-4-ol; terpinolene; thuj-3-en-10-al; thuja-2,4(10)-diene; trans-calamenen-10-ol; trans-carveol; trans-pinocarveol; trans-sabinol; trans-verbenol; verbenone; viridiflorol; α-cadinol; α-cubebene; α-humulene; α-phellandrene; α-pinene; α-terpinene; α-terpineol; α-thujene; β-eudesmol; β-pinene; γ-terpinene; δ-cadinene; δ-terpineol; τ-muurolol[122]		

Table 1 (*Continued*)

S. No.	Plant	Part used	Chemical constituent	Pharmacological activity	Medicinal use
10.	*Cinnamomum iners* Reinw. ex Blume	Leaves	*Aldehyde*: Cinnamic aldehyde.[124] *Acetate*: (E)-phytol acetate.[125] *Fatty acid*: Linoleic acid.[126] *Terpinenes*: Terpene[124]; (E)-caryophyllene; (E)-nerolidol; (E)-β-ocimene; geraniol; linalool; β-pinene; β-selinene; α-humulene; α-pinene; α-selinene[125]; (+)-aromadendrene, (−)-bornyl acetate, 2,6-octadien-1-ol, 2-propen-1-ol, 3-allyl-6-methoxyphenol, alloaromadendrene, aromadendrene,benzyl benzoate, borneol L, cadinol, calarene, caryophyllene, caryophyllene oxide, *cis*-linalool oxide, *cis*-α-bergamotene, cyclohexene, dodecanal, epiglobulol, geraniol, germacrene-D, isospathulenol, linalool, naphthalene,1,2,3,4,4a,7-hexahydro, nerolidol, palustrol, propanoic acid, spathulenol, terpinen-4-ol, tetradecanal, *trans*-linalool oxide, viridiflorol, α-amorphene, α-cadinol, α-copaene, α-copaene, α-cubebene, α-humulene, α-longipinene, α-muurolene, α-terpineol, β-bisabolene, β-elemene, β-selinene, δ-cadinene[127]	Analgesic.[128] anticancer,[129,130] antidiabetic,[131,132] antihyperlipidaemic,[132] anti-inflammatory,[130] antikinase,[133] antimicrobial,[134–136] antioxidant,[130,133,137] antiplasmodial,[138] glutathione-S-transferase inhibitory activity,[139] toxicological studies[128,140]	Abdominal pain,[115] appetite problems,[141] asthma[142], breathing problem[141], body ache[54], cardiac disorders[143], constipation[134], cough and cold [142,144], diarrhoea[145], digestive ailments[141], dysentery[62,146], dyspepsia[124], dyspnoea[144], flatulence[124], gynaecological disorder[95], headache[147], influenza[148], insects bite[149], jaundice[150], nausea and vomiting[115,151], postpartum[115,147], pyrexia[95,124], rheumatism[152], stomach complains[134,145], urinary diseases[124], wounds[153]
		Stem	*Acetate*: (E)-Phytol acetate.[125] *Terpinenes*: 1,8-Cineole, α-terpinol, terpinen-4-ol[16]; (E)-caryophyllene; (E)-nerolidol; (E)-β-ocimene; geraniol; linalool; β-pinene; β-selinene; α-humulene; α-pinene; α-selinene[125]		
11.	*Cinnamomum insularimontanum* Hayata	Fruit	*Terpinenes*: 4-Terpineol; borneol; camphene; caryophyllene; cineol; Citral; citronellal; citronellol; geraniol; limonene; β-myrcene; β-pinene; α-pinene[154]	Anticancer,[155] anti-inflammatory,[154] antioxidant,[130] antiviral,[156] cytotoxicity[156]	Headache,[157] blood circulation[157]
		Root	Actinodaphnine[155,158]		
		Stem	Cinnamic acid; cinnamyl alcohol; coumarin; kaempferitrin; kaempferol; p-hydroxybenzoic acid; stigmasterol; β-sitosterol[158]; polysaccharides; dehydrosulfurenic acid; 15α-acetyldehydrosulfurenic acid[157]		
		Leaf	Polysaccharides, dehydrosulfurenic acid, 15α-acetyldehydrosulfurenic acid[157]		
12.	*Cinnamomum javanicum* Blume	Plant	2,6-Dimethyl-1,7-octadiene-3,6-cliol; 2,6-dimethyl-3,7-octadiene-2,6-cliol; 4-hydroxy-4-methyl-2-pentanooe 2-butoxyethanol; 5-ethenyldihydro-5-methyl-2(3H)-furanone; 6-ethenyltetrahydro-2,2,6-trimethyl-2H-pyrao-3-ol; 8,11-octadecadienoic acid, methyl ester; acetic acid; benzaldehyde; eucalyptol; hexadecanoic acid, methyl ester; palmitic acid vinyl ester; phytol; styrene; tetradecanal; trans-linalool oxide; tridecanal[159]	Anticholinesterase,[160] antimicrobial,[159,161] antioxidant,[159,160] antityrosinase,[160] antiviral,[162] cytotoxicity,[162] platelet-activating factor (PAF) receptor-binding antagonist,[39] toxicological studies[162]	Abdominal disorders,[17] abortion,[163] abscess,[164] chest pain,[17] fatigue,[17] gynaecological disorder,[163] lethargy,[17] postpartum,[162] spasmodic colic,[165] sexual debility[163]
13.	*Cinnamomum kotoense* Kaneh. & Sasaki	Leaves	2″-O-cis-p-Coumaroyl-4″-O-trans-p-coumaroylafzelin[166] (+)-catechin; (+)-syringaresinol, (−)-catechin, (−)-epicatechin, (−)-sesamin, 3-O-α-L-[2,4-di-(E)-p-coumaroyl]rhamnopyranoside; 3-O-α-L-[2-(Z)-p-coumaroyl-4-(E)-p-coumaroyl]rhamnopyranoside; cinnakotolactone, clemaphenol A, ferulic acid, isoeugenol, isokotomolide A, isolinderanolide B; isoobtusilactone A, kotomolide A and B, obtusilactone A; p-hydroxybenzaldehyde, palmitic acid, pluviatilol, secokotomolide A, stearic acid; stigmasterol, stigmasteryl-D-glucoside, syringaldehyde, vanillic acid, vanillin, β-sitosterol, β-sitosterol-D-glucoside[167–169]	Anticancer,[168–171] antioxidant,[172] antiproliferative,[167] antitubercular,[173] osteoinductive effect,[174] toxicological[171]	Headache,[157] blood circulation[157]
		Fruit	*Butanolides*: isoobtusilactone, obtusilactone A.[175] *Lignans*: (+)-syringaresinol.[175] *Steroids*: β-sitosterol, stigmasterol[175]		

Table 1 (Continued)

S. No.	Plant	Part used	Chemical constituent	Pharmacological activity	Medicinal use
		Stem	(+)-Catechin, (−)-4′-hydroxy-5,7,3′-trimethoxyflavan-3-ol, (−)-catechin, (−)-sesamin, (±)-syringaresinol, 2,6-dimethoxy-1,4-benzoquinone, 2-acetyl-5-dodecylfuran, 2-acetyl-5-methylfuran, 4-hydroxybenzaldehyde, apigenin, benzoic acid, docosanoic acid, genkwanin, isoobtusilactone A, kaempferol, kotodiol, kotolactone A and B, lauric acid, lincomolide B, margaric acid, methyl palmitate, methyl stearate, palmitic acid, protocatechuic acid, quercetin, secokotomolide, squalene, stearic acid, stigmasterol, stigmasteryl-3-O-β-D-glucoside, syringaldehyde, tetracosane trans-coumaric acid, trans-ferulic acid, trans-phytol, vanillin, β-sitosterol β-sitosterol-3-O-β-D-glucoside[173]		
14.	*Cinnamomum laubatii* F.Muell	Leaf	*Propenes*: Safrole.[176] *Propenoids*: Methyl eugenol.[176] *Terpinenes*: (E)-β-Ocimene; 1,8-cineole; bicyclogermacrene; C15 H26 O (A); C15 H26 O (B); camphene; caryophyllene oxide; cubeban-11-ol; cubenol; epicubenol; globulol; humulene; limonene; myrcene; p-cymene; sabinene; spathulenol; terpinolene; viridiflorol; β-caryophyllene; β-cubebene; β-elemene; β-pinene; β-selinene; δ-3-carene; α-phellandrene; α-pinene; α-selinene; α-terpinene; α-thujene[176]	Anticancer[177]	Flatulence,[178] gynaecological complains,[178] urinary disease[178]
15.	*Cinnamomum loureiroi* Nees	Bark	Phenols,[179] alkaloid, anthraquinones, coumarins, flavonoid, phenols, saponins, tannins.[180] *Flavonoids*: Cinnamic aldehyde[179,181]; 3-methoxycinnamaldehyde; cinnamaldehyde.[181] *Hydrocarbons*: Copaene; α-amorphene; β-cadinene.[181] *Terpinenes*: Caryophyllene; phellandrene; pinene[179,182]; cadinadiene-4,9; cubenol; limonene; α-cedrene oxide; α-guaiene; α-myrcene; β-pinene[181]	Antidiabetic,[46] anti-inflammatory,[180,183] antiviral[184]	Abdominal pain,[180] atherosclerosis,[180] blood pressure lowering,[180] carcinogenesis,[180] cardiovascular diseases,[180] chest congestion,[180] cholesterol lowering,[180] conjunctivitis,[180] cough and cold,[180] diarrhoea,[179] erectile dysfunction,[180] flatulence,[179] headache,[180] indigestion,[180] inflammations,[182] muscular strains,[182] nausea,[179,182] neuralgia,[180] rheumatism,[180,182] sore throat,[180] tooth ache,[180] vaginal problems,[180] vomiting,[180,182] wound,[180] yeast infections[180]
16.	*Cinnamomum macrocarpum* Hook.f.	Bark	*Aldehydes*: Benzaldehyde; hydrocinnamaldehyde.[185] *Carboxylic acid*: Benzoic acid; butanoic acid; propanoic acid.[185] *Fatty acid*: Isovaleric acid.[185] *Flavonoids*: Cinnamaldehyde.[185] *Hydrocarbons*: Copaene; cyclohexene; naphthalene; γ-cadinene.[185] *Terpinenes*: (+)-α-Terpineol; 1,3-cyclohexadiene; 1,4-cyclohexadiene; 1,6-cyclodecadiene; 1,6-octadien-3-Ol; 1,6-octadiene; 2-norbornanol; 3-carene; 4-terpineol; bicyclo hept-3-ene,-3-care; camphene; camphor; caryophyllene; cineole; cubenol; cymene; cymol; eucalyptol; linalool; nerolidol A; sabinene; spathulenol; β-myrcene; β-pinene; γ-elemene; γ-muurolene; δ-cadinene; α-caryophyllene; α-cubebene; α-fenchol; α-humulene; α-phellandrene; α-pinene; α-selinene; α-terpinene; α- terpinolene[185]		
		Leaf	*Carboxylic acid*: Benzoic acid; butanoic acid; propanoic acid.[185] *Flavonoids*: Cinnamaldehyde.[185] *Hydrocarbons*: 1-Naphthalenol; copaene; naphthalene; β-cadinene; δ-cadinene.[185] *Terpinenes*: (−)-Bornanone; 1,3-cyclohexadiene; 1,4-cyclohexadiene; 1,6-cyclodecadiene; 1,6-octadien-3-Ol; 3-carene; 4-carvomenthenol; 4-terpineol; bicyclo α-thujene; caryophyllene; cedr-8-ene; cineole; cis-α-bisabolene; cymene; cymol; eucalyptol; germacrene-D; linalool; sabinene; spathulenol; thujene; β-myrcene; β-pinene; γ-terpinene; η-ocimene; α-(+)-pinene; α-caryophyllene; α-cubebene; α-humulene; α-phellandrene; α-terpinene; α-terpinolene,[185] camphor, cis-calamenene, germacrene B[186]	Anticholinesterase,[160,186] antioxidant,[160,186] antityrosinase[160]	Cough and cold,[187] diarrhoea,[187] dysentery,[187] rheumatism,[188,189] sciatica pains[189]

Table 1 (*Continued*)

S. No.	Plant	Part used	Chemical constituent	Pharmacological activity	Medicinal use
17.	*Cinnamomum mercadoi* S.Vidal	Leaves	Sapogenin; alkaloids, safrole[190]	Analgesic,[190] antidiarrhoeal,[191] anti-inflammatory,[190] antimicrobial,[190,192,193] antioxidant[192,194]	Appetite,[194] bloating,[194] bronchitis,[194] cough and cold,[194] diabetes,[195] dysentery,[194] headaches,[115] flatulence,[194] intestinal troubles,[115] neuralgic pains,[194] menstrual problems,[194] pyrexia,[194] rheumatism,[191] skin diseases,[194] sinus,[194] Stomach troubles,[194] toothache,[194] tuberculosis,[115] vomiting,[194] yeast infections[194]
		Seed	Sapogenin[190]		
		Roots	Safrole[190]		
		Bark	*Terpinenes*: 1,8-Cineol; camphene; limonene; linalool; myrcene; p-cymene; sabinene; terpinen-4-ol; terpinolene; β-pinene; γ-terpinene; α-pinene; α-terpinene; α-terpineol[196]		
18.	*Cinnamomum micranthum* f. *kanehirae* (Hayata) S.S.Ying	Leaf	*Aldehyde*: Benzaldehyde.[197] *Hydrocarbons*: α-Copaene; γ –cadinene.[197] *Terpinenes*: (−)-nerolidol; (−)-terpinen-4-ol; 1,8-cineole; 10-epi-cubebol; 3-carene; caryophyllene oxide; cis-linalool oxide; cis-β-ocimene; citronellol; citronellol acetate; E-citral; epi-cubenol; geraniol; germacrene-D; guaiol; limonene; linalool; nerol; p-cymene; sabinene; spathulenol; T-cadinol; T-muurolol; trans-linalool oxide; trans-β-caryophyllene; trans-β-ocimene; Z-citral; α-cadinol; α-humulene; α-muurolene; α-phellandrene; α-pinene; α-terpinene; α-terpineol; α-terpinyl acetate; α-thujene; α-ylangene; β-elemene; β-myrcene; β-pinene; β-selinene; γ -muurolene; γ -terpinene; δ-cadinol; δ-selinene; δ-terpineol[197]	Anticancer[198,199], antimicrobial[200]	Dispel apathy,[198] lung problems,[198] nervous depression[198]
19.	*Cinnamomum mollissimum* Hook.f.	Leaf	*Carboxylic acid*: Benzoic acid.[201] *Terpinenes*: Linalool; spathulenol; β-caryophyllene; α -terpineol [201,202]; carvacrol; d-cadinene; nerolidol; p-cymene; sabinol; T-cadinol; terpinen-4-ol; viridiflorol; zingiberene; β-bisabolene; β-farnesene; β-maaliene; γ-farnesene; α -cadinol; α -caryophyllene; α -phellandrene; α -selinene[201]; bisabolol; bisabolol oxide A; dehydrolinalool; E-β-ocimene; limonene; myrcene; β-bisabolene; β-pinene; γ-terpinene; δ-cadinene; α-cadinene; α-cadinol; α-humulene; α-pinene; α-thujene.[202] 1,8-cineole[20,203]	Antimicrobial,[20,204] antioxidant,[205] antityrosinase,[205] insecticidal[203]	
		Bark	*Alkaloids*: Hernagine, hernovine, isocorydine, N-methylhernagine, N-methylhernovine.[205] *Carboxylic acid*: Hexanoic acid.[201] *Terpinenes*: Cineole; copaene; limonene; linalool; terpinen-4-ol; β-caryophyllene l429; β-elemene; β-pinene; γ-muurolene; α -caryophyllene; α -phellandrene; α-pinene; α -terpineol[201]		
		Wood	*Terpinenes*: Cineole; linalool; nerolidol; β-maaliene; γ-muurolene; α-phellandrene; α-terpineol[201]		
20.	*Cinnamomum oliveri* F.M.Bailey	Bark	*Terpinenes*: Camphor, Pinene[206]	Antimicrobial,[204,207], toxicological[204,207]	Cough and cold,[208] diarrhoea,[178] dysentery,[178] gastrointestinal tract,[208] inflammation,[204] phthisis,[208] rheumatism,[204] skin disorders,[204] swellings[204]
		Leaves	*Terpinenes*: Borneol; camphene; camphor; limonene; linalool; myrcene; p-cymene; spathulenol; viridiflorol; β-caryophyllene; β-pinene; δ-cadinene; α-cadinol; α-pinene; α-terpineol[176]		

Table 1 (Continued)

S. No.	Plant	Part used	Chemical constituent	Pharmacological activity	Medicinal use
21.	*Cinnamomum osmophloeum* Kaneh.	Twig	3-O-[β-D-Xylopyranosyl-(1 → 2)-α-L-arabinofuranoside], 7-O-α-L-rhamnopyranoside; sagittatin A.[166] L-borneol, α-terpineol, p-allylanisole, *trans*-cinnamaldehyde, L-bornyl acetate, eugenol, α-copaene, β-caryophyllene, cinnamyl acetate, α-caryophyllene, curcumene, δ-cadinene, α-calacorene, elemicin, e-nerolidol, spathulenol, caryophyllene oxide, *trans*-β-elemenone, γ-eudesmol, caryophylla-4 (14), 8(15)-dien-5.α-ol, δ-cadinol, T-cadinol, cadalene, guaiol acetate[209] *Kaempferol glycosides*: (kaempferol 3-O-β-D-xylopyranosyl-(1 → 2)-α-L-arabinofuranosyl-7-O-α-L-rhamnopyranoside, kaempferol 3-O-β-D-xylopyranosyl-(1 → 2)-α-L-rhamnopyranosyl-7-O-α-L-rhamnopyranoside, kaempferol 3-O-β-D-glucopyranosyl-(1 → 2)-α-L-arabinofuranosyl-7-O-α-L-rhamnopyranoside, kaempferol 3-O-α-L-rhamnopyranosyl-(1 → 2)-α-L-arabinofuranosyl-7-O-α-L-rhamnopyranoside, kaempferol 3-O-β-D-apiofuranosyl-(1 → 2)-α-L-arabinofuranosyl-7-O-α-L-rhamnopyranoside, kaempferol 3-O-β-D-glucopyranosyl-(1 → 2)-α-L-rhamnopyranosyl-7-O-α-L-rhamnopyranoside, kaempferol 3-O-β-D-glucopyranosyl-(1 → 4)-α-L-rhamnopyranosyl-7-O-α-L-rhamnopyranoside, kaempferitrin, kaempferol 7-O-α-L-rhamnopyranoside[210]	Anticancer,[130,211] antidiabetic,[212,213] antidyslipidaemic,[214] anti-inflammatory,[209,215] antimicrobial[216,217], antioxidant,[213,218] cardioprotective,[219] cytotoxicity,[220] hair growth,[221] hepatoprotective,[222] hypolipidaemic effect,[223] hypouricaemic effects,[224] immunomodulatory,[225] larvicidal,[29] pancreas-protective effect,[226] tyrosinase,[220,227] wound healing,[227] xanthine oxidase inhibitory[224]	Arthritis,[228] cough and cold,[228] diabetes,[228] infection,[222] inflammation,[228] nerve pains,[228] pyrexia[228]
		Bark	*Flavonoids*: (E)-Cinnamaldehyde; (Z)-cinnamaldehyde.[229] *Hydrocarbon*: Phenol; γ-muurolene[229] *Terpinenes*: 1,8-Cineole; 2-hydroxy-1,8-cineol; 4-terpineol; camphene; caryophyllene; caryophyllene oxide; cedrol; citronellol; copacamphene; d-carvone; geranial; geraniol; geranyl acetate; isoborneol; limonene; linalool; menthone; myrcene; neral; nerol; ocimene; p-cymene; phytol; piperitone; spathulenol; T-cadinol; terpinolene; trans-linalool oxide; β-pinene; γ-cadinene; γ-humulene; α-pinene; α-terpinene; α-terpineol; α-terpinyl acetate[229]		
		Leaves	*Flavonoids*: cis-Cinnamaldehyde; trans-cinnamaldehyde[5,230,231]; cinnamaldehyde.[232] *Hydrocarbon*: γ-Cadinene; δ-cadinene; α-copaene[232]; copaene.[231] *Terpinenes*: Camphor; γ-muurolene[230,232]; limonene; linalool[231]; camphene; caryophyllene oxide[5,230,231]; geraniol; α-cadinol; α-humulene[5,230]; β-pinene; α-terpineol[231]; geranyl acetate; α-caryophyllene; α-muurolene[116,230]; guaiol; β-caryophyllene; β-phellandrene; γ-elemene; T-cadinol[230]; caryophyllene[231,232]; β-bourbonene[232]; 1,8-cineol; cedrol; spathulenol; T-muurolol; trans-β-caryophyllene; δ-cadinene; δ-cadinol[5]; p-cymene; α-pinene[5,231]; (+)-4-carene; (E)-ocimene; 3-carene; cis-β-terpineol; D-limonene; eucalyptol; germacrene-D; neral; nerol; sabinene; terpin-4-ol; terpinolene; β-humulene; β-myrcene; γ-terpinene; α-farnesene; α-phellandrene; α-thujene[231]		
		Stem	*Flavonoids*: Kaempferol; kaempferol 3-O-α-L-rhamnopyranoside; kaempferol 7-O-α-L-rhamnopyranoside; kaempferol 3-O-α-L-rhamnopyranoside-7-O- α-L-rhamnopyranoside; kaempferol 3-O-α-L-rhamnopyranosyl-(1-2)- α-L-rhamnopyranoside[233]		
		Heartwood and roots	9,9′-Di-O-feruloyl-5,5′-dimethoxysecoisolariciresinol, (7′S,8′R,8R)-lyoniresinol-9-O-(E)-feruloyl ester, (7′S,8′R,8R)-lyoniresinol-9,9′-di-O-(E)-feruloyl ester, secoisolariciresinol, (−)-lyoniresinol[211]		

Table 1 (*Continued*)

S. No.	Plant	Part used	Chemical constituent	Pharmacological activity	Medicinal use
22.	*Cinnamomum parthenoxylon* (Jack) Meisn.	Root bark	*Fatty acid*: Myristic acid; palmitic acid; pentadecanoic acid[234]; *Hydrocarbons*: Alloaromadendrene; guaiazulene; γ-cadinene; δ-cadinene; α-copaene.[234] *Terpinenes*: Cadalene; caryophyllene oxide; germacrene-D; spathulenol; valencene; viridiflorol; β-bisabolene; β-elemene; β-selinene; δ-cadinol (torreyol); α-cadinol; α-humulene; α-muurolene[234]	Antidiabetic,[235] anti-inflammatory,[236] antileukaemic,[237] antimicrobial,[50,238,239] antioxidant,[240] antityrosinase,[205] cytotoxic,[239] haemagglutinating,[241] hepatoprotective,[240] RNA N-glycosidase activity[241]	Anaemia,[242] amenorrhoea,[243] backache,[243] blood circulation,[243] childbirth,[236] dysentery,[235] dyspepsia,[243] impotence,[243] pertussis,[235] pyrexia,[238] rheumatism,[165,244] rheumatoid arthritis,[235] stomach troubles,[238] traumatic injury,[244] wound[245]
		Wood	*Aldehydes*: Benzaldehyde; piperonal.[234] *Fatty acid*: Myristic acid; palmitic acid; pentadecanoic acid.[234] *Terpinenes*: δ-Cadinol (torreyol); α-cadinol[234]		
		Stem bark	*Aldehyde*: Benzaldehyde.[41] *Flavonoid*: Cinnamaldehyde.[41] *Terpinenes*: 1,8-Cineole; borneol; bicyclogermacrene; camphene; camphor; caryophyllene oxide; linalool; myrcene; terpinen-4-ol; terpinolene; β-caryophyllene; β-cymene; β-phellandrene; β-pinene; α-farnesene; α-humulene; α-phellandrene; α-pinene; α-terpinolene[41]		
		Leaves	(3R, 4R, 3R, 4R)-6,6′-Dimethoxy-3, 4, 3′,4′-tetrahydro-2H, 2′H-[3, 3′]bichromenyl-4, 4′-diol; 1,2,4-trihydroxybenzene; 4-hydroxybenzaldehyde; daucosterol; herbacetin; kaempferol-3-O-α-L-rhamnoside; quercetin-3-O-α-L-rhamnoside; β-sitosterol,[246] methyl eugenol, β-sitosterol and stigmast-4-en-3-one.[205] *Flavonoid rutinosides*: Scopoletin, isorhoifolin, epicatechin, blumenol A, 4-hydroxybenzoic acid, rutin, hexadecanoic acid methyl ester, nicoflorin.[240] *Aldehyde*: Benzaldehyde.[41] *Terpinenes*: 1,8-Cineole; borneol; camphene; caryophyllene oxide; linalool; myrcene; terpinen-4-ol; terpinolene; β-caryophyllene; β-cymene; β-phellandrene; β-pinene; γ-terpinene; α-humulene; α-pinene; α-terpinolene[41]		
		Bark	Safrole, methyl eugenol, elemicin[247]		
23.	*Cinnamomum rhynchophyllum* Miq.	Leaf	Benzyl benzoate, cis-β-guaiene, eugenol, limonene, linalool, methyl(E)-cinnamate, methyl eugenol, myrcene, p-cymene, sabinene, safrole, spathulenol, terpinen-4-ol, terpinolene, α-humulene, α-phellandrene, α-pinene, α-terpinene, α-terpineol, α-thujene, β-phellandrene, β-pinene, β-selinene, β-caryophyllene, γ-terpinene, δ-3-carene, δ-cadinene[20]	Antimicrobial,[20] insecticidal[203]	Antiaging,[248] food poisoning,[17] intestinal problem,[115] sexual debility,[248] stomach ache[17]
		Bark	(E)-Asarone, benzyl benzoate borneol, camphor, linalool, methyl(E)-cinnamate, methyl eugenol, p-cymene, sabinene, safrole, spathulenol, terpinen-4-ol, α-humulene, α-pinene, α-terpineol, α-thujene, β-caryophyllene, γ-terpinene[20]		
24.	*Cinnamomum scortechinii* Gamble	Leaf	*Hydrocarbons*: α-Copaene; δ-cadinene.[249] *Terpinenes*: (E)-Nerolidol; (Z)-nerolidol; (Z)-β-ocimene; allo-ocimene; borneol; camphor; geranial; geraniol; globulol; limonene; linalool; myrcene; neral; nerol; sabinene; spathulenol; terpinen-4-ol; terpinolene; viridiflorol; α-bisabolol; α-humulene; α-muurolene; α-phellandrene; α-pinene; α-terpinene; α-terpineol; β-caryophyllene; β-phellandrene; β-pinene; β-selinene; β-sesquiphellandrene; γ-muurolene; γ-terpinene; δ-3-carene.[249]	Anticholinesterase,[160] antimicrobial,[20] antioxidant,[160] antityrosinase,[160] insecticidal,[203] platelet-activating factor (PAF) receptor-binding antagonist activity[40]	Influenza[148]
		Bark	*Hydrocarbons*: α-Copaene; δ-cadinene.[249] *Terpinenes*: (E)-Nerolidol; (E,E)-α-farnesene; (Z)-nerolidol; 1,8-cineole; borneol; camphene; caryophyllene oxide; cis-linalool oxide (furanoid); citronellal; farnesene; Geranial; geraniol; limonene; linalool; neral; nerol; p-cymen-8-ol; p-cymene; sabinene; spathulenol; terpinen-4-ol; terpinolene; α-cubebene; α-fenchol; α-humulene; α-pinene; α-selinene; α-terpineol; β-bisabolol; β-caryophyllene; β-elemene; β-eudesmol; β-pinene; β-selinene; β-sesquiphellandrene; γ-eudesmol; δ-elemene[249]		

Table 1 (*Continued*)

S. No.	Plant	Part used	Chemical constituent	Pharmacological activity	Medicinal use
25.	*Cinnamomum sintoc* Blume	Leaf	*Hydrocarbons*: α-Cadinene; γ-cadinene; δ-cadinene.[250] *Terpinenes*: 1,8-Cineole; caryophyllene oxide; germacrene-D; limonene; linalool; myrcene; p-cymene; terpinen-4-ol; trans-linalool oxide; α-cadinol; α-humulene; α-terpineol; β-caryophyllene; β-elemene; β-pinene; γ-elemene; γ-muurolene; γ-terpinene[250]	Analgesic,[251] anti-inflammatory,[251] antimicrobial,[252] insecticidal,[203] platelet-activating factor (PAF) receptor-binding antagonist activity[39]	Abdominal pain,[253] animal bites,[254] diarrhoea,[253] dysentery,[251] fatigue,[115] flatulence,[252] epilepsy,[254] intestinal complaints,[253] insects bite,[253] inflammation,[251] mouth freshener,[253] numbness,[253] pyrexia,[115,252] rheumatism,[254] snake bite,[253] swelling,[254] syphilis,[253] tiredness,[115] ulcer[253]
		Bark	1,8-Cineol, 4-terpineol, aromadendrene, benzyl benzoate, borneol, bornyl acetate, camphor, caryophyllene oxide, derivative eugenol, eugenic acid, eugenol, germacrene, globulol, hexadecanoic acid, isomyristicin, isopulegol, juniper camphor, L-limonene, L-linalool, methyl eugenol, myristicin, safrole, spathulenol, trans-caryophyllene, thymol, viridiflorol, α-cadinol, α-calacorene, α-curcumene, α-muurolene, α-terpineol, α-copaene, β-caryophyllene, γ-muurolene, δ-cadinene, δ-cadinol.[251] *Aldehyde*: Dodecanal; tetradecanal; undecanal.[250] *Fatty acid*: Tetradecanoic acid.[250] *Hydrocarbons*: Dodecane; γ-cadinene; δ-cadinene.[250] *Terpinenes*: 1,8-Cineole; borneol; camphene; cis-linalool oxide; cubenol; epi-α-cadinol; geraniol; germacrene B; limonene; linalool; myrcene; nerol; p-cymene; terpinen-4-ol; trans-linalool oxide; α-humulene; α-muurolene; α-pinene; α-selinene; α-terpineol; α-thujene; α-ylangene; β-elemene; β-pinene; β-selinene; γ-muurolene; γ-terpinene[250]		
		Wood	*Aldehyde*: Benzaldehyde; decanal; Dodecanal; hexanal; octadecanal; tetradecanal; undecanal.[250] *Fatty acid*: Hexadecanoic acid; octadecanoic acid; pentadecanoic acid; tetradecanoic acid.[250] *Hydrocarbons*: Dodecane; α-copaene; γ-cadinene.[250] *Terpinenes*: 1,8-Cineole; cis-linalool oxide; epi-α-cadinol; linalool; p-cymene; terpinen-4-ol; trans-linalool oxide; α-humulene; α-terpineol; α-ylangene[250]		
		Twig	*Aldehyde*: Benzaldehyde; tetradecanal.[250] *Hydrocarbons*: α-Copaene; γ-cadinene; δ-cadinene.[250] *Terpinenes*: (E)-β-Farnesene; (E,E)-α-farnesene; 1,8-cineole; cis-linalool oxide; linalool; p-cymene; terpinen-4-ol; trans-linalool oxide; α-terpineol; β-caryophyllene; β-elemene[250]		
26.	*Cinnamomum subavenium* Miq.	Root	3,4-Methylenedioxy-5-methoxy cinnamyl alcohol; eugenol; isoobtusilactone A; myristicin; obtusilactone A,[255] subamol.[256] isoobtusilactone A, obtusilactone A, eugenol, myristicin, cinnamyl alcohol[255]	Anticancer activity,[130,257] anti-inflammatory,[130] antioxidant,[130,172,255] antityrosinase,[258], enzyme inhibitory[259]	Abdominal pain, chest pain, diarrhoea, hernia, nausea, rheumatism, stomach aches, swellings, vomiting[260]
		Stem	(+)-Catechin, (+)-syringaresinol, (−)-epicatechin, (−)-sesamin, ferulic acid, isolinderanolide B, linderanolide B6, p-hydroxybenzaldehyde, palmitic acid, secosubamolide, stearic acid, stigmasterol, stigmasteryl-D-glucoside, subamolides A-C, syringaldehyde, vanillic acid, vanillin, β-sitosterol, β-sitosterol-D-glucoside[257]		

Table 1 (*Continued*)

S. No.	Plant	Part used	Chemical constituent	Pharmacological activity	Medicinal use
		Leaf	(3R,4R)-p-Menth-1-ene-3,4-diol 3-O-β-D-glucopyranoside; (3R,4S,6R)-p-menth-1-ene-3,6-diol 3-O-β-D-glucopyranoside; (3S,5R,6S,7E)-megastigma-7-ene-3,5,6,9-tetrol; (4R)-p-menthane-1,2α,8-triol 1α, 6β-dihydroxy-5,10-bis-epi-eudesm-15-carboxaldehyde-6-O-β-D-glucopyranoside; 3,4,5-trimethoxyphenyl-1-O-β-D-glucoside; 3-hydroxy-4,5-dimethoxyphenyl-β-D-glucopyranoside; acaricide B1; D-threo-guaiacylglycerol 7-O-β-D-glucopyranoside; wilsonol G; wilsonol H; α-D-glucoside.[261] (2R)-naringenin 5-O-β-D-glucopyranoside; (2S)-naringenin 5-O-β-D-glucopyranoside; (aR)- and (aS)-subavenoside A; (aR)- and (aS)-subavenoside B; (aR)- and (aS)-subavenoside C; (aR)- and (aS)-subavenoside D; (aR)- and (aS)-subavenoside E; (aR)- and (aS)-subavenoside F; (aR,7R)-6,7-dihydrosubavenoside A; (aR,7R)- and (aS,7S)-6,7-dihydrosubavenoside D; (aR,7R)-dihydrisosubamol; (aS,7S)-6,7-dihydrosubavenoside A; 1-butyrylphloroglucinol β-D-glucopyranoside; 3-hexenyl β-D-glucopyranoside; 3-O-α-L-rhamnopyranoside; 3-O-α-L-rhamnopyranosyl-(1 → 6)-β-D-glucopyranoside; 3-O-β-D-glucopyranoside; 7-O-β-D-glucopyranoside; kaempferol; 9,12-Di-O-methylsubamo; chavicol 4-O-β-D-apiofuranosyl-(1 → 6)-β-D-glucopyranoside; D-1; dihydrodehydrodiconiferyl alcohol β-D-xylopyranoside; epicatechin; gibberellin; hydroxytyrosol; nine flavonoids, catechin; phloridzin; two tannins, cinnamtannins B-1[259] *Fatty acids*: Hexadecanoic acid[262] *Hydrocarbons*: Cadalene; pentacosane; tridecane; α-copaene; δ-cadinene.[262] *Others*: (E)-Methyl cinnamate; (E)-α-ionone; (Z)-isoeugenol; benzyl benzoate; cis-calamenene; cis-α-bergamotene; cubenol; dodecene; elemol; geranyl acetate; geranyl formate; methyl eugenol; trans-pinocarveol; α-cubebene; α-cyperone.[262] cinnamtannins B-1 and D-1,[259] subamone[263] *Terpinenes*: (E)-Nerolidol; (E)-β-farnesene; 1,8-cineole; aristolone; borneol; camphene; cis-linalool oxide; geranial; geraniol; linalool; myrcene; neral; p-cymene; patchouli alcohol; spathulenol; terpinen-4-ol; trans-linalool oxide; viridiflorol; α-bisabolol; α-cadinol; α-humulene; α-muurolene; α-muurolol; α-pinene; α-terpineol; β-bisabolene; β-caryophyllene; β-pinene; β-selinene; γ-muurolene; γ-terpinene[262]		
		Bark	*Fatty acids*: Hexadecanoic acid; Pentadecanoic acid; Tetradecanoic acid[262] *Hydrocarbons*: Cadalene; tridecane; δ-cadinene.[262] *Terpinenes*: (E)-Nerolidol; 1,8-cineole; aristolone; borneol; camphene; cis-linalool oxide; geranial; geraniol; linalool; myrcene; neral; p-cymene; patchouli alcohol; spathulenol; terpinen-4-ol; trans-linalool oxide; viridiflorol; α-bisabolene; α-bisabolol; α-cadinol; α-cedrene; α-muurolene; α-muurolol; α-pinene; α-terpineol; β-bisabolene; β-cedrene; β-pinene; β-selinene; γ-muurolene; γ-terpinene[262]		

Table 1 (*Continued*)

S. No.	Plant	Part used	Chemical constituent	Pharmacological activity	Medicinal use
27.	*Cinnamomum sulphuratum* Nees	Leaf	*Fatty acid*: Palmitic acid (hexadecanoic acid).[264] *Flavonoid*: (E)-Cinnamaldehyde[41] *Hydrocarbons*: α-Amorphene; α-copaene; δ-cadinene[264] *Terpinenes*: (E)-Nerolidol; camphor; perillene; γ-terpinene; α-fenchol[41]; 1-linalool[265]; α-phellandrene[266]; citronellol; β-pinene[41,265]; β-caryophyllene[41]; β-phellandrene[41]; linalool[41]; (Z)-β-ocimene[264,266]; α-muurolene; spathulenol[41,264]; 1,8-cineole; caryophyllene oxide; p-cymene; terpinen-4-ol; α-humulene; α-terpineol[41]; limonene; β-pinene[195,264]; caryophyllene alcohol; germacrene-D; α-cadinol; α-muurolol; α-selinene; β-bisabolene; β-elemene; β-selinene[264]; borneol; cis-linalool oxide (furanoid); citronellal; geranial; geranyl acetate; myrcene; neral; terpinolene; trans-linalool oxide (furanoid)[41,195]; camphene; geraniol; nerol; α-pinene[41,195,265]; geranyl formate; piperitone; α-fenchol[195]	Anti-inflammatory[267], antimicrobial[268], hepatoprotective[103]	Arthritis,[269] backache,[103] cholera,[265] cough and cold,[270] diabetes,[271] dyspepsia,[265] headache,[270] insects bite,[270] menstrual problems,[272] oral problems,[270] pyrexia,[265,272] worm infestation[272], wounds,[103] urinary problems[103]
		Stem bark	*Flavonoid*: (E)-Cinnamaldehyde; (Z)-cinnamaldehyde[41,195] *Hydrocarbon*: δ-Cadinene[41,195]; α-copaene[41,195,264] *Terpinenes*: Camphor; caryophyllene oxide; β-phellandrene; β-pinene[41]; limonene; linalool; β-pinene[41,195,264]; spathulenol[264]; 1,8 cineole; borneol; camphene; geranial; p-cymene; terpinen-4-ol; β-bisabolene; β-caryophyllene; α-fenchol; α-humulene; α-muurolene; α-pinene; α-terpineol[41,195]		
		Bark	Anthraquinones, cyanogenic glycosides, glycosides, leucoanthocyanins, saponins, steroids, triterpenes[103]		
28.	*Cinnamomum tenuifolium* (Makino) Sugim.	Leaves	Ethyl 3,5-dihydroxy-4-nitrobenzoate[273]; 2,3-dihydro-6,6-dimethylbenzo[b][1,5]dioxocin-4(6H)-one[274]; (+) spathulenol, 1,8-cineole, 1-phellandrene, 2 borneol L, benzaldehyde, bicyclo, bornyl acetate, calarene, camphene, carvone, caryophyllene oxide, elemol, limonene, linalool, p-cymen-8-ol, sabinene, terpinen-4-ol, α-pipene, α-terpineol, β-eudesmol, β-myrcene, β-pinene, γ-gurjunene, δ-selinene, δ3-carene.[275] *Enzyme*: l-Kaurene.[276] *Hydrocarbons*: d-δ-Cadinene; l-copaene; ε-cadinene.[276] *Terpenes*: 1,8-Cineole; camphene; camphor; cis-linalool oxide; citronellol; d-cis-yabunikkeol; geraniol; l-caryophyllene; l-linalool; l-trans-yabunikkeol; l-α-phellandrene; l-α-terpineol; limonene; nerol; p-cymene; terpinen-4-ol; trans-linalool oxide; β-elemene; β-myrcene; β-pinene; α-cadinol; α-humulene; α-pinene[276]	Antiangiogenic,[277] anticancer,[278] antimicrobial,[279] antioxidant,[280] antiplatelet aggregation[281]	Anaemia,[282] arthralgia,[282] gastrointestinal pain,[282] lochia,[282] lumbago,[282] respiratory tract problems[90]
		Twig	*Enzyme*: l-Kaurene[276] *Hydrocarbons*: d-δ-Cadinene; l-copaene; ε-cadinene.[276] *Others*: 3-Hexen-1-ol; calamenene; elemol; eugenol; l-carvone; methyl eugenol; safrole; undefined ketone; unidentified alcohol; unidentified sesquiterpene hydrocarbon(SHC); β-calacorene; α-calacorene; α-terpinyl acetate.[276] *Terpenes*: 1,8-Cineole; camphene; camphor; cis-linalool oxide; citronellol; d-cis-yabunikkeol; geraniol; l-caryophyllene; l-linalool; l-trans-yabunikkeol; l-α-phellandrene; l-α-terpineol; limonene; nerol; p-cymene; terpinen-4-ol; trans-linalool oxide; β-elemene; β-myrcene; β-pinene; α-cadinol; α-humulene; α-pinene[276]		
		Branchlets	*Hydrocarbons*: d-δ-Cadinene; l-copaene; ε-cadinene.[276] *Terpenes*: 1,8-Cineole; camphene; camphor; cis-linalool oxide; citronellol; d-cis-yabunikkeol; geraniol; l-caryophyllene; l-linalool; l-trans-yabunikkeol; l-α-phellandrene; l-α-terpineol; limonene; nerol; p-cymene; terpinen-4-ol; trans-linalool oxide; β-elemene; β-myrcene; β-pinene; α-cadinol; α-humulene; α-pinene[276]		

Table 1 (Continued)

S. No.	Plant	Part used	Chemical constituent	Pharmacological activity	Medicinal use
		Stem	Tenuifolide A [(4S,3Z)-4-hydroxy-5-methylene-3-heptacosylidenedihydrofuran-2-one]; isotenuifolide A [(4S,3E)-4-hydroxy-5-methylene-3-heptacosylidenedihydrofuran-2-one]; tenuifolide B [3-(1-methoxyeicosyl)-5-methylene-5H-furan-2-one]; secotenuifolide A {methyl[(2E)-2-[(1R)-1-hydroxy-2-oxopropyl]heptacos-2-enoate]}; tenuifolin {(3-methoxy-5H-9,11-dioxabenzo[3,4]cyclohepta[1,2-f]) inden-7-yl) methanol}[278]; (+)-sesamin, (+)-syringaresinol, 4-allylcatechol, alpinenone, catechin, *epi*catechin, eugenol 4-O-methyl ether, ferulic acid, isoobtusilactone A, isotenuifolide A, myristicin, obtusilactone A, p-hydroxybenzaldehyde, palmitic acid, secotenuifolide A, stearic acid, tenuifolide A and B, tenuifolin, β-sitostenone, β-sitosterol, β-sitosterol-D-glucoside[278]		
29.	*Cinnamomum travancoricum* Gamble	Bark	Anthraquinones, cardiotonic glycosides, cyanogenic glycosides, leucoanthocyanins, saponins, steroids, triterpenes,[103] essential oils, fixed oils, sapanin, sugar, tannins, triterpenoids[109]	Antimicrobial,[268] cytotoxic,[109] hepatoprotective[103]	Asthma,[283] backache,[103] cough and cold,[283] dental diseases,[283] mouth diseases,[283] thirst,[283] vomiting,[283] wounds,[103] urinary problems[103]
		Leaf	Essential oils, sapanin, sugar, tannins, triterpenoids.[109]		
30.	*Cinnamomum tazia* (Buch.-Ham.) Kosterm. ex M.Gangop.	Leaf	*Flavonoids*: (Z)-Cinnamaldehyde; cinnamaldehyde (=(E)-cinnamaldehyde).[41,284] *Hydrocarbon*: Azulene.[114] *Terpinenes*: (E)-Nerolidol; 1,8-cineole; borneol; camphene; caryophyllene oxide; cis-linalool oxide (furanoid); limonene; linalool; p-cymene; sabinene; terpinen-4-ol; trans-linalool oxide (furanoid); β-pinene; α-pinene; α-terpineol.[41,284] cineol; limonene; terpineol[114]	Antioxidant[285]	Asthma,[286] bronchitis,[286] cardiac problems,[114] diarrhoea,[286] dysentery,[55] muscular strains,[114] nausea,[286] rheumatism,[114] stomach disorder,[41,284] skin diseases[114]
		Stem	*Flavonoids*: (Z)-Cinnamaldehyde; cinnamaldehyde (=(E)-cinnamaldehyde)[41] *Hydrocarbon*: Azulene.[114] *Terpinenes*: (2)-β-Farnesene;(E)-nerolidol; (E,E)-α-farnesene; 1,8-cineole; borneol; camphene; caryophyllene oxide; linalool; p-cymene; terpinen-4-ol; β-caryophyllene; β-pinene; α-humulene; α-pinene; α-terpineol[41]; cineol; limonene; terpineol[114]		
		Root bark	*Flavonoids*: (Z)-Cinnamaldehyde; cinnamaldehyde (=(E)-cinnamaldehyde)[41] *Terpinenes*: (E)-Nerolidol; (E,E)-α-farnesene; 1,8-cineole; borneol; camphene; caryophyllene oxide; cis-linalool oxide (furanoid); limonene; linalool; p-cymene; T-cadinol; terpinen-4-ol; terpinolene; trans-linalool oxide (furanoid); β-caryophyllene; β-pinene; α-cadinol; α-humulene; α-pinene; α-terpineol[41]		
31.	*Cinnamomum walaiwarense* Kosterm.	Bark	Anthraquinones; cardiotonic glycosides; cyanogenic glycosides; leucoanthocyanins; saponins; steroids; triterpenes[103]; essential oils; fixed oils; sapanin; sugar; tannins; triterpenoids[109]	Antimicrobial,[268] antioxidant,[287] cytotoxic,[109] hepatoprotective,[103] hypoglycaemic[287]	Backache,[103] headaches,[288] menstrual problems,[288] pyrexia,[288] urinary problems,[103] wound[103]
		Leaf	Essential oils; sapanin; sugar; tannins; triterpenoids[109]; benzyl benzoate[287]		
32.	*Cinnamomum wightii* Meisn.	Bark	Cinnamic aldehyde, cinnamyl acetate[289]	Antioxidant,[290] cytotoxic,[109] hepatoprotective,[103] larvicidal[291]	Abdominal disorders,[289,292] colic,[292] constipation,[292] cough and cold,[289,292] diarrhoea,[292] dysuria,[289,292] gynaecological disorders,[292,293] headache,[293] indigestion,[289,292] insect bite,[292] mumps,[289] nerves disorder,[294] paralytic disorders,[292] pyrexia,[293] rheumatism,[292] stress,[294] worm infestation,[292] wounds[293]
		Leaves	*Flavonoid*: Cinnamic aldehyde; quercetin- 3-0-rutinoside; terpinenes: α-pinene; p- cymene; β-pinene; limonene; geraniol[292]		
33.	*Cinnamomum wilsonii* Gamble	Bark	Cinnamic aldehyde; eugenol; methyl eugenol; mucilage; phellandrene; tannin[295]	Anticancer,[296] antioxidant,[297] immunomodulatory[296]	Abdominal disorders,[295,296] anaemia,[295] lumbago,[295] wounds[295,296]
		Leaves	(+)-(6S,7E,9Z)-Abscisic ester; apocynol A, lasianthionoside A, wilsonols A-I[296]		

Table 2 Details of clinical trials[32] with keyword 'cinnamon'

Clinical trials	Title	Status	Study results
NCT01301521	Cinnamon trial-lifestyle intervention plus water-soluble cinnamon extract on lowering blood glucose in pre-diabetics	Active, not recruiting	No results available[32]
NCT03778099	The effect of cinnamon on ovulation induction in women with polycystic ovary syndrome	Recruiting	No results available[32]
NCT01302743	Cinnamon bark, water-soluble cinnamon extract, and metformin for treatment of type 2 DM	Terminated	No results available[32]
NCT01847053	Bioavailability study of cinnamon in healthy subjects	Completed	No results available[32]
NCT00331279	The effect of cinnamon extract on insulin resistance parameters in polycystic ovary syndrome: a pilot study	Completed	No results available[32]
NCT00445354	Randomized controlled clinical trial of cinnamon to lower haemoglobin A1c	Completed	No results available[32]
NCT00371800	The effect of cinnamon on HbA1c among adolescents with type I diabetes	Completed	No results available[32]
NCT01483118	Cinnamon extract on menstrual cycles in polycystic ovary syndrome (PCOS)	Completed	The changes in insulin resistance parameters in overweight patients with PCOS between baseline and after 6 months of daily cinnamon compared to the corresponding change in patients receiving 6 months of placebo. Higher values of insulin resistance represent a worse outcome. A higher value homoeostasis model of insulin resistance indicates more insulin resistance so higher values are worse outcomes (a score of >2 is considered healthy for adults with scores >5 being considered severe insulin resistance). For the Quant. Insulin Sensitivity Check Index, a lower value indicates more insulin resistance so lower values are worse outcomes (values can range from 0.45, which is considered normal in health individuals and 0.30, which is characteristic of diabetes)[32]
NCT00237640	Effect of cinnamon on glucose and lipid levels in non-insulin dependent type 2 diabetes mellitus	Completed	No results available[32]
NCT00951639	Cassia cinnamon for glucose uptake in young women	Completed	No results available[32]
NCT00846898	Is there a metabolic effect of cinnamon on HbA1c, blood pressure and serum lipids in type 2 diabetes mellitus?	Completed	No results available [32]
NCT00970541	Effect of cinnamon extract on insulin resistance in polycystic ovary syndrome	Terminated	No results available[32]
NCT03061916	Cinnamon and ginger in comparison to chlorhexidine gluconate 0.2% on oral *Streptococcus mutans*	Unknown status	No results available[32]
NCT03219411	Effects of Cinnamon supplementation on glucose metabolism in patients with pre-diabetes	Active, not recruiting	No results available[32]
NCT02942056	The effect of cinnamon cassia on diabetes control and cardiometabolic risk factors in adults with type 2 diabetes mellitus	Not yet recruiting	No results available[32]
NCT00479973	The anti-diabetic and cholesterol-lowering effects of cinnamon and cassia bark	Unknown status	No results available[32]

Table 2 (*Continued*)

Clinical trials	Title	Status	Study results
NCT02455778	Effect of oral cinnamon intervention in metabolic syndrome	Completed	No results available [32]
NCT01027585	The effects of cinnamon on postprandial blood glucose, and insulin in subjects with impaired glucose tolerance	Completed	No results available[32]
NCT03711682	Reducing plasma glucose effect of cinnamon in type 2 diabetic patients in the Municipality of Comasagua	Completed	No results available[32]
NCT01734187	Efficacy and safety of fermented cinnamon vine powder on decrement of body fat	Unknown status	No results available[32]
NCT03813914	A new supplement for the 'metabolic syndrome'	Completed	No results available[32]
NCT01350284	The effect of natural food flavouring on gastrointestinal and cardiovascular physiological responses	Completed	No results available [32]
NCT03061799	Efficacy and safety of HPC-03 for postmenopausal symptom	Unknown status	No results available[32]
NCT01530685	Gycabiane and glycemic control of prediabetic subjects	Unknown status	No results available [32]
NCT02074423	A human clinical trial evaluating the effect of MealShapeâ „¢ on blood glucose level following consumption of standard meal	Completed	No results available[32]
NCT03388762	RCT of a polyherbal dietary supplement for prediabetes	Recruiting	No results available[32]

Chemical composition of cinnamon

Polyphenols and volatile phenols are the two chemical classes which are isolated from *C. zeylanicum*. Cinnamon mostly contains ferulic acids, caffeic, gallic, vanillic, protocatechuic and *p*-coumaric along with the polyphenols (Figure 1a).[33] The chemical composition of cinnamon essential oil in regard to volatile components is depended on the plant part from which they are extracted. Cinnamaldehyde (Figure 1b) with a content ranging from 90% to 62%–73% is the most represented substance extracted from bark essential oil.[34] Hydrocarbons and oxygenated compounds (i.e. benzyl benzoate, β-caryophyllene, cinnamyl acetate, linalool and eugenyl acetate) are the other minor volatile compounds (Figure 1b). Eugenol having higher concentration >80% and (E)-cinnamyl acetate and caryophyllene is the main component of cinnamon leaf oil and cinnamon flowers and fruit (Figure 1b).[35–37]

Conclusion

Modern and traditional medicinal along with the chemical and pharmaceutical system is mostly dependent on medicinal plants for their drug requirements. Aromatic plants are mostly used for fragrances, cosmetics and health beverages. Researchers and scientist examine the medicinal plants to improve the drug development. At present scenario, about three-quarters of the world population depends on these medicinal plants for health concerns. Cinnamon bark has various chemical compounds used as a spice all over the world. Cinnamon has been shown to possess different biological and pharmacological actions for the treatment of various diseases such as cancer, diabetes, inflammation, microbial infection, nerves disorder, abdominal disorder, asthma, bronchitis, urinary infection, arthritis, anaemia and blood pressure because of their bioactive compounds. So, cinnamon as a multipurpose medicinal spice plays an important role in modern medicine system. As we know, in modern era all people attracted to herbal medicine to treat various ailments safely. Therefore, in this review, we summarized the pre-existing studies on the in-vivo and in-vitro pharmacological activity of *Cinnamomum*. However, various scientists identified many compounds but extensive research is still needed to explore the mechanism and function of other unidentified compounds to fight which can be used to cure several diseases.

Declarations

Conflict of interest

The authors declare no conflict of interests.

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Author contributions

All authors participated in the search and analysis of the articles and books, and also in the writing of the manuscript. All authors have read and approved the final manuscript.

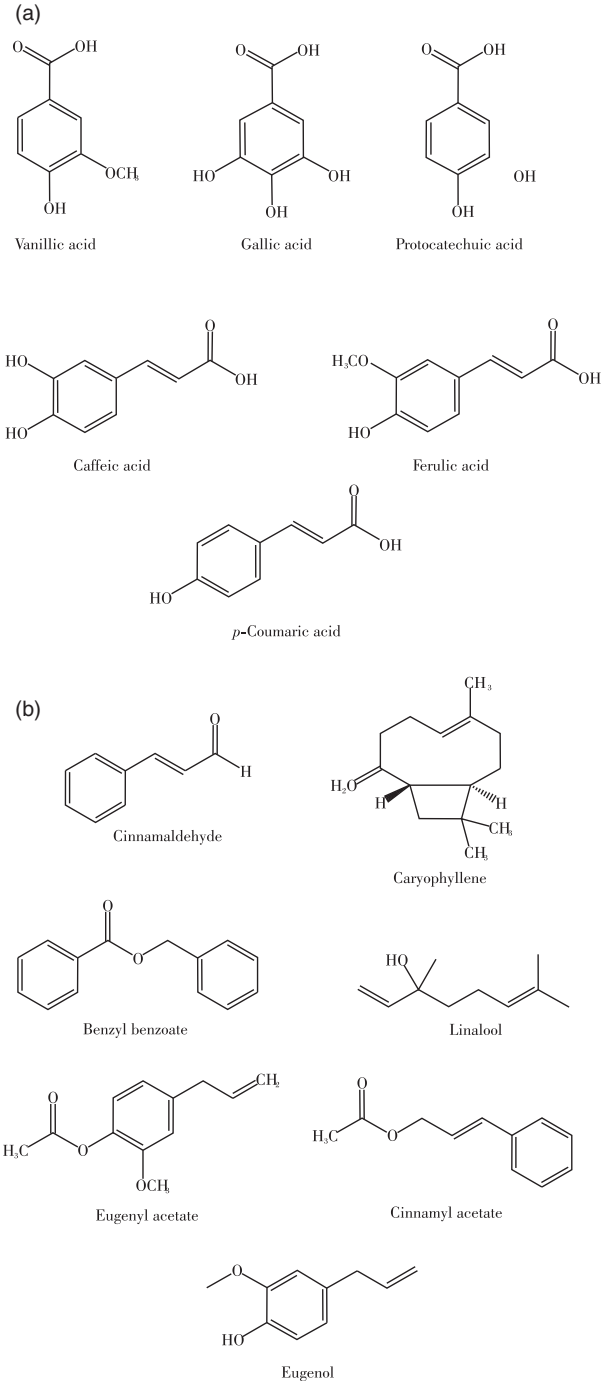

Figure 1 (a) Polyphenolic constituents and (b) chemical compounds of cinnamon essential oil.

References

1. Kumar S *et al*. Pharmacological and pharmacognostical aspects of *Cinnamomum* tamala Nees and Eberm. *J Pharm Res* 2012; 5: 480–484.
2. Lee J *et al*. Analysis of the trans-cinnamic acid content in *Cinnamomum* spp. and commercial cinnamon powder using HPLC. *J Agric Chem Environ* 2015; 4: 102.
3. Sangal A. Role of cinnamon as beneficial antidiabetic food adjunct: a review. *Adv Appl Sci Res* 2011; 2: 440–450.
4. Vangalapati M *et al*. A review on pharmacological activities and clinical effects of cinnamon species. *Res J Pharm Biol Chem Sci* 2012; 3: 653–663.
5. Yeh HF *et al*. Methods for thermal stability enhancement of leaf essential oils and their main constituents from indigenous cinnamon (*Cinnamomum osmophloeum*). *J Agric Food Chem* 2013; 61: 6293–6298.
6. Suresh P *et al*. Antibacterial activity of eugenol in comparison with other antibiotics. *J Food Sci Technol* 1992; 29: 254–256.
7. Ali SM *et al*. Antimicrobial activities of eugenol and cinnamaldehyde against the human gastric pathogen *Helicobacter pylori*. *Ann Clin Microbiol Antimicrob* 2005; 4: 20.
8. Senanayake UM *et al*. Volatile constituents of cinnamon (*Cinnamomum zeylanicum*) oils. *J Agric Food Chem* 1978; 26: 822–824.
9. Killday KB *et al*. Bioactive A-type proanthocyanidins from *Cinnamomum cassia*. *J Nat Prod*. 2011; 74: 1833–1841.
10. Nonaka GI *et al*. Tannins and related compounds. Part 13. Isolation and structures of trimeric, tetrameric, and pentameric proanthicyanidins from cinnamon. *J Chem Soc Perkin 1* 1983; 2139–2145.
11. Büyükbalci A, El SN. Determination of in vitro antidiabetic effects, antioxidant activities and phenol contents of some herbal teas. *Plant Foods Hum Nutr* 2008; 63: 27–33.
12. Kim SH *et al*. Anti-diabetic effect of cinnamon extract on blood glucose in db/db mice. *J Ethnopharmacol* 2006; 104: 119–123.
13. Verspohl EJ *et al*. Antidiabetic effect of *Cinnamomum* cassia and *Cinnamomum zeylanicum* in vivo and in vitro. *Phytother Res* 2005; 19: 203–206.
14. Wijesekera R. Historical overview of the cinnamon industry. *Crit Rev Food Sci Nutr* 1997; 10: 1–30.
15. Sulaiman SAB. Extraction of essential oil from *Cinnamomum zeylanicum* by various methods as a perfume oil. Bachelor thesis, University of Malaysia Pahang, Gambang, Pahang, Malaysia, 2013.
16. Barceloux DG. Cinnamon (*Cinnamomum* species). *Dis Mon* 2009; 55: 327–335.
17. Wuu-Kuang S. Taxonomic revision of *Cinnamomum* (Lauraceae) in Borneo. *Blumea Biodivers Evol Biogeogr Plants* 2011; 56: 241–264.
18. Cardoso-Ugarte GA *et al*. Cinnamon (*Cinnamomum zeylanicum*) essential oils. In: Preedy VR, ed. *Essential Oils in Food Preservation, Flavor and Safety*. San Diego, CA: Academic Press, 2016: 339–347. (Chapter 38).
19. Leela J. Cinnamon and Cassia. In: Parthasarathy V, Chempakam B, Zachariah T, eds. *Chemistry of Spices*. Cambridge, MA: CABI, 2008.
20. Jantan I *et al*. Correlation between chemical composition and antifungal activity of the essential oils of eight *Cinnamomum* species. *Pharm Biol* 2008; 46: 406–412.
21. Jakhetia V *et al*. Cinnamon: a pharmacological review. *JASR* 2010; 1: 19–23.
22. Krishnamoorthy B, Rema J. End uses of cinnamon and cassia. In:Ravindran PN, Babu KN eds. *Cinnamon and Cassia: The Genus Cinnamomum*. Boca Raton, FL: CRC Press, 2004.
23. Samy J, Sugumaran M, Lee KLW. *Herbs of Malaysia: An introduction to medicinal, culinary, aromatic and cosmetic use of herbs*. Selangor, Malaysia: Marshall Cavendish Publications Sdn. Bhd, 2005,23.
24. Burkill IH. A Dictionary of the Economic Products of the Malay Peninsula. Government of Malaysia and Singapore.1966; 549–566.
25. Pereira JT, Hastie AYL. The Cinnamon Trees, *Cinnamomum* Schaeff. (Lauraceae) in Sabah. Annual Report. Sabah Forestry Department 2014: 365–360.
26. Chang S-T, Cheng S-S. Antitermitic activity of leaf essential oils and components from *Cinnamomum osmophleum*. *J Agric Food Chem* 2002; 50: 1389–1392.
27. Mancini-Filho J *et al*. Antioxidant activity of cinnamon (*Cinnamomum Zeylanicum*, Breyne) extracts. *Boll Chim Farm* 1998; 137: 443–447.
28. Tung Y-T *et al*. Anti-inflammation activities of essential oil and its constituents from indigenous cinnamon (*Cinnamomum osmophloeum*) twigs. *Bioresour Technol* 2008; 99: 3908–3913.
29. Cheng S-S *et al*. Chemical composition and mosquito larvicidal activity of essential oils from leaves of different *Cinnamomum osmophloeum* provenances. *J Agric Food Chem* 2004; 52: 4395–4400.
30. Kong J-O *et al*. Nematicidal activity of cassia and cinnamon oil compounds and related compounds toward *Bursaphelenchus xylophilus* (Nematoda: Parasitaphelenchidae). *J Nematol* 2007; 39: 31.
31. Moselhy SS, Ali HK. Hepatoprotective effect of cinnamon extracts against carbon tetrachloride induced oxidative stress and liver injury in rats. *Biol Res* 2009; 42: 93–98.
32. U.S. National Institutes of Health, ClinicalTrials.gov. http://clinicaltrial.gov/
33. Muchuweti M *et al*. Phenolic composition and antioxidant properties of some spices. *Am J Food Technol* 2007; 2: 414–420.
34. Wong YC *et al*. Extraction of essential oil from cinnamon (*Cinnamomum* zeylanicum). *Orient J Chem* 2014; 30: 37–47.
35. Jayaprakasha GK *et al*. Limonoids from *Citrus reticulata* and their moult inhibiting activity in mosquito *Culex quinquefasciatus* larvae. *Phytochemistry* 1997; 44: 843–846.
36. Jayaprakasha GK *et al*. Chemical composition of the flower oil of

Cinnamomum zeylanicum Blume. *J Agric Food Chem* 2000; 48: 4294–4295.
37. Filoche SK *et al*. Antimicrobial effects of essential oils in combination with chlorhexidine digluconate. *Oral Microbiol Immunol* 2005; 20: 221–225.
38. Ali NAM *et al*. Chemical composition and antimicrobial activities of the essential oils of *Cinnamomum aureofulvum* Gamb. *J Essent Oil Res* 2002; 14: 135–138.
39. Jantan I *et al*. Platelet-activating factor (PAF) receptor-binding antagonist activity of Malaysian medicinal plants. *Phytomedicine* 2005; 12: 88–92.
40. Baruah A, Nath SC. *Aromatic and Spice Plants: Utilisation and Conservation*. Jaipur, India: Aavishkar Publishers, 2011.
41. Adhikari MK *et al*. *Medicinal plants of Nepal*. Kathmandu, Nepal: Government of Nepal, Ministry of Forests and Soil Conservation, 2007.
42. Insung A *et al*. Effectiveness of essential oils of medicinal plants at reducing the amounts of allergen produced by the European house dust mite, *Dermatophagoides pteronyssinus* (Trouessart). *J Acarol Soc of Jpn* 2016; 25: S179–S184.
43. Gogoi B *et al*. In vitro antihelmintic activity of bark extract of *Cinnamomum bejolghota* (Buch.-Ham.) in Indian adult earthworm (*Pheretima posthuma*). *Asian Pac J Trop Dis* 2014; 4: S924–S927.
44. Nanasombat S *et al*. Antimicrobial activity of Thai medicinal plants against beverage spoilage microorganisms and their potential in retarding Alzheimer's disease progression. *Pharmacogn Commun* 2014; 4: 77–87.
45. Gogoi B *et al*. Antihyperglycemic and in vivo antioxidative activity evaluation of *Cinnamomum bejolghota* (Buch.-Ham.) in streptozotocin induced diabetic rats: an ethnomedicinal plant in Assam. *Asian Pac J Trop Med* 2014; 7: S427–S434.
46. Adisakwattana S *et al*. Inhibitory activity of cinnamon bark species and their combination effect with acarbose against intestinal α-glucosidase and pancreatic α-amylase. *Plant Foods Hum Nutr* 2011; 66: 143–148.
47. Wannissorn B *et al*. Antibacterial properties of essential oils from Thai medicinal plants. *Fitoterapia* 2005; 76: 233–236.
48. Yan-Jiao D *et al*. Screening of antibacterial activity of 20 Chinese herbal medicines in Yunnan. *Afr J Pharm Pharmacol* 2013; 7: 2859–2865.
49. Bordoloi PK. Some investigations in search of potential bioactive molecules of natural and synthetic origin. Published doctoral thesis. Dibrugarh University, Dibrugarh, Assam, India,2012.
50. Limsuwan S, Voravuthikunchai SP. Anti-*Streptococcus pyogenes* activity of selected medicinal plant extracts used in Thai traditional medicine. *Trop J Pharm Res* 2013; 12: 535–540.
51. Klinthong S *et al*. In vivo anti-inflammatory and in vitro antioxidant activities of a Thai traditional formula, Rid-si-duang-ma-ha-kan, for hemorrhoid treatment. *Mahidol Univ J Pharm Sci* 2015; 42: 144–152.
52. Tuekaew J *et al*. Evaluation of the antioxidant activities of Ya-hom Intajak, a Thai herbal formulation, and its component plants. *Trop J Pharm Res* 2014; 13: 1477–1485.
53. Gogoi B *et al*. Pharmacognostic and preliminary phytochemical evaluation of *Cinnamomum bejolghota* (Buch.-Ham.) Sweet bark. *Indian J Nat Prod Resour* 2016; 7: 59–64.
54. Uddin SN. Traditional uses of Ethnomedicinal plants of the Chittagong Hill Tracts. Bangladesh National Herbarium, 2006.
55. Gupta AK, Tandon N, eds. *Reviews on Indian Medicinal Plants* (Vol. 6). New Delhi, India: Indian Council of Medical Research, 2004.
56. Kumar S. *The Medicinal Plants of North East India*. Jodhpur, India: Scientific Publishers, 2002.
57. Singh B *et al*. A survey of ethnomedicinal plants utilized by the indigenous people of Garo Hills with special reference to the Nokrek Biosphere Reserve (Meghalaya), India. *J Herbs Spices Med Plants* 2014; 20: 1–30.
58. Basu SK *et al*. *Encyclopedia of Himalayan Medicinal Flora* (Vol. 1). Kolkata, India: Horticulture Development Foundation, The Agri Horticultural Society of India, 2007.
59. Lalramnghinglova H. *Ethno-Medicinal Plants of Mizoram*. Dehradun, India: Bishen Singh and Mahendra Pal Singh, 2003.
60. Lalramnghinglova H. Documentation of medicinal plants based on traditional practices in the Indo-Burma Hotspots Region of Mizoram, North East India. *Emer Life Sci Res* 2016; 2: 10–45.
61. Baral SR, Kurmi PP. *A Compendium of Medicinal Plants in Nepal*. Kathmandu, Nepal: Mass Printing Press, 2006.
62. Kirtikar KR, Basu BD. *Indian Medicinal Plants* (Vol. 3). Dehradun, India: International Book Distributors Booksellers & Publishers, 1999.
63. Doley B *et al*. CEthnomedicinal uses of different species of *Cinnamomum Schaeffer* (Lauraceae) by ethnic communities in Arunachal Pradesh, India. *Pleione* 2009; 3(1): 9–12.
64. Ahmed AA, Borthakur SK. *Ethnobotanical Wisdom of Khasis: Hynniew Treps of Meghalaya*. Dehradun, India: Bishen Singh Mahendra Pal Singh, 2005.
65. Atiphasaworn P *et al*. Chemical composition, antibacterial and antifungal activities of *Cinnamomum bejolghota* bark oil from Thailand. *J Appl Pharm Sci* 2017; 7: 69–73.
66. Choudhury S *et al*. Composition of the bark and flower oils of *Cinnamomum bejolghota* (Buch.-Ham.) sweet from two locations of Assam, India. *J Essent Oil Res* 1998; 10: 245–250.
67. Chen L *et al*. A new source of natural D-borneol and its characteristic. *J Med Plants Res* 2011; 5: 3440–3447.
68. Al-Dhubiab BE. Pharmaceutical applications and phytochemical profile of *Cinnamomum burmannii*. *Pharmacog Rev* 2012; 6: 125.
69. Lestari B *et al*. A comparison of antimetastatic activity between *Nerium*

indicum and *Cinnamomum burmannii* on 4T1 cells. *Indones J Cancer Chemoprevention* 2017; 8: 85–93.
70. Daker M *et al.* Inhibitory effects of *Cinnamomum burmannii* Blume stem bark extract and trans-cinnamaldehyde on nasopharyngeal carcinoma cells; synergism with cisplatin. *Exp Ther Med* 2013; 5: 1701–1709.
71. Silva ML. Beneficial effects of *Cinnamomum burmannii* in the treatment of diabetes mellitus, Doctoral dissertation. University of Central Lancashire, 2015.
72. Khatib A *et al.* Anti-inflammatory activities of *Cinnamomum burmannii* BI. *Food Sci Biotechnol* 2005; 14: 223–227.
73. Choi EM, Hwang JK. Screening of Indonesian medicinal plants for inhibitor activity on nitric oxide production of RAW264. 7 cells and antioxidant activity. *Fitoterapia* 2005; 76: 194–203.
74. Awanga AFI *et al.* The mode of antimicrobial action of *Cinnamomum burmannii*'s essential oil & cinnamaldehyde. *Jurnal Teknologi* 2016; 78: 41–47.
75. Pratiwi SUT *et al.* Effect of *Cinnamomum burmannii* Nees ex Bl. and *Massoia aromatica* Becc. Essential oils on planktonic growth and biofilm formation of *Pseudomonas aeruginosa* and *Staphylococcus aureus* in vitro. *Int J Appl Res Nat Prod* 2015; 8: 1–13.
76. Huang S *et al.* Antioxidant activities and UV-protective properties of melanin from the berry of *Cinnamomum burmannii* and *Osmanthus fragrans*. *Med Chem Res* 2011; 20: 475–481.
77. Zaino Q *et al.* Antipyretic effect of *Cinnamomum burmannii* (Nees & T. Nees) Blume infusion in fever-induced rat models. *Althea Med J* 2014; 1: 100–104.
78. Cao H *et al.* Cinnamon polyphenol extract affects immune responses by regulating anti-and proinflammatory and glucose transporter gene expression in mouse macrophages. *J Nutr* 2008; 138: 833–840.
79. Cao H *et al.* Cinnamon extract regulates glucose transporter and insulin-signaling gene expression in mouse adipocytes. *Phytomedicine* 2010; 17: 1027–1032.
80. Nailufar F, Tjandrawinata RR. The evaluation of proton pump inhibitor bioactive fraction DLBS2411 from *Cinnamomum burmannii* (Nees & T. Nees) in animal model of gastric ulceration healing. *Am J Pharmacol Toxicol* 2018; 12: 79–88.
81. Wahyuningsih D *et al.* *Cinnamomum burmannii* protected hepatocytes and corrected serum urea and uric acid level in diabetic rats. *J Islam Med Res* 2017; 1: 34–41.
82. Pratiwi TS, Putri A, Murwani S (2015). The effect of *Cinnamomum burmannii* extract as an immunomodulator on the increase of GR-1 expressing IFNγ and macrophage. https://www.researchgate.net/publication/292970746_The_Effect_of_Cinnamomum_burmannii_Extract_as_an_Immunomodulator_on_the_Increase_of_GR-1_Expressing_IFNg_and_Macrophage. Accessed 3 Apr 2019.
83. Panickar KS *et al.* Cinnamon polyphenols attenuate cell swelling and mitochondrial dysfunction following oxygen-glucose deprivation in glial cells. *Exp Neurol* 2009; 216: 420–427.
84. Priani SE *et al.* Development of sunscreen emulgel containing *Cinnamomum burmannii* stem bark extract. *Int J Sci Res* 2014; 3: 2338–2339.
85. Deepa C *et al.* Wound healing activity of hydro-alcoholic extract of *Cinnamomum nitidum* Blume (Lauraceae) in wistar albino rats. *Curr Tradit Med* 2016; 2: 134–145.
86. Herdwiani W *et al* Gas chromatograph-mass spectrometer analysis and acute oral toxicity of *Cinnamomum burmannii*., Ness Ex Bl. essential oil. *Asian J Pharm Clin Res* 2016; 9: 240–245.
87. Ahmad M *et al.* Safety assessment of standardised methanol extract of *Cinnamomum burmannii*. *Phytomedicine* 2013; 20: 1124–1130.
88. Duke JA, Ayensu ES. *Medicinal Plants of China* (Vol. 2). Michigan, China: Reference Publication, 1985.
89. Awang AFIB*et al.*Antimicrobial activity and synergic effect of *Cinnamomum burmannii*'s essential oil & its isolated compound (cinnamaldehyde). In Proceeding Paper of International Conference on Chemical, Agricultural and Medical Sciences (CAMS-2013) (pp. 29–30), 2013.
90. Huang H*et al.* Healthy Modern Landscape Inherited from Hakka Culture. In MATEC Web of Conferences, EDP Sciences, 82, 03007.
91. Houdkova M *et al.* In vitro growth-inhibitory effect of Cambodian essential oils against pneumonia causing bacteria in liquid and vapour phase and their toxicity to lung fibroblasts. *S Afr J Bot* 2018; 118: 85–97.
92. Chhouk K *et al.* Efficacy of supercritical carbon dioxide integrated hydrothermal extraction of Khmer medicinal plants with potential pharmaceutical activity. *J Environ Chem Eng* 2018; 6: 2944–2956.
93. Pel P *et al.* Chemical constituents with anti-allergic activity from the barks of *Cinnamomum cambodianum* collected in Cambodia. *Bull Korean Chem Soc* 2015; 36: 384–387.
94. Lee DS *et al.* Protective effects of Cambodian medicinal plants on tert-butyl hydroperoxide-induced hepatotoxicity via Nrf2-mediated heme oxygenase-1. *Mol Med Rep* 2017; 15: 451–459.
95. Uphof JCT. *Dictionary of Economic Plants* second revised and enlarged edition. Dehradun, India: Bishen Singh Mahendra Pal Singh, 2001.
96. Ashwell D, Walston N. *An Overview of the Use and Trade of Plants and Animals in Traditional Medicine System in Cambodia*. Hanoi, Vietnam: Traffic Southeast Asia, 2008.
97. Son LC *et al.* Study on *Cinnamomum* oils: compositional pattern of seven species grown in Vietnam. *J Oleo Sci* 2014; 63: 1035–1043.
98. Cinnamomum caryophyllus (Lour.) Moore- công dụng De cẩm chướng. (n.d.). Retrieved January 12, 2019, from http://tracuuduoclieu.vn/Cinnamomum-caryophyllus-lour-moore.html.
99. Hapsari Y, Simanjuntak P. Study Senyawa Kimia Dalam Fase Ekstrak Etil Asetat Simplisia *Cinnamomum* spp. Secara KCKT dan KG-SM.

Jurnal Kimia Mulawarman 2010; 8: 23–27.
100. Hapsari Y. Studi kimia dan farmakologi: tumbuhan obat Indonesia, kayu lawang, (*Cinnamomum* culilaban (L.) Presl.), Published Master's thesis. University of Indonesia, Depok, Indonesia, 2010.
101. Jansen PCM (2016). Cinnamomum culitlawan (PROSEA). Retrieved January 19, 2019, from https://uses.plantnet-project.org/e/index.php?title=Cinnamomum_culitlawan_(PROSEA)&oldxml:id=200838.
102. Rameshkumar KB *et al*. Chemical constituents and antimicrobial activity of the leaf oil of *Cinnamomum filipedicellatum* Kosterm. *J Essent Oil Res* 2006; 18: 234–236.
103. Maridass M. Hepatoprotective activity of barks extract of six *Cinnamomum* species on carbon tetrachloride-induced in albino rats. *Folia Med Indones* 2009; 45: 204–207.
104. Baruah A, Nath SC. Leaf essential oils of *Cinnamomum glanduliferum* (Wall) Meissn and *Cinnamomum glaucescens* (Nees) Meissn. *J Essent Oil Res* 2006; 18: 200–202.
105. Azab SS *et al*. Anti-inflammatory and gastroprotective potential of leaf essential oil of *Cinnamomum glanduliferum* in ethanol-induced rat experimental gastritis. *Pharm Biol* 2017; 55: 1654–1661.
106. Singh C *et al*. Chemical composition of the leaves essential oil from *Cinnamomum glanduliferum* (Wall) Meissn from Uttarakhand, India. *J Essent Oil Bear Plant* 2014; 17: 927–930.
107. Taha AM, Eldahshan OA. Chemical characteristics, antimicrobial, and cytotoxic activities of the essential oil of Egyptian *Cinnamomum glanduliferum* bark. *Chem Biodivers* 2017; 14: e1600443.
108. Singh C *et al*. Exploration of antimicrobial potential of essential oils of *Cinnamomum glanduliferum*, *Feronia elephantum, Bupleurum hamiltonii* and *Cyclospermum leptophyllum* against foodborne pathogens. *Pharm Biol* 2013; 51: 1607–1610.
109. Maridass M. Evaluation of brine shrimp lethality of *Cinnamomum* species. *Ethnobotanical Leaflets* 2008; 12: 772–775.
110. Youssif RS, Shaalan EA. Mosquitocidal activity of some volatile oils against *Aedes caspius* mosquitoes. *J Vector Borne Dis* 2011; 48: 113–115.
111. Greeshma AG *et al*. Plants used as antimicrobials in the preparation of traditional starter cultures of fermentation by certain tribes of Arunachal Pradesh. *Bull Arunachal For Res* 2006; 22: 52–7.
112. Saha G *et al*. Survey of medicinal plants in the Gorumara National Park, Jalpaiguri, West Bengal, India. *Pleione* 2013; 7: 127–137.
113. Sharma HK *et al*. Traditional medicinal plants in Mizoram, India. *Fitoterapia* 2001; 72: 146–161.
114. Ahmed M. *Medicinal Plants*. Chennai, India: MjP Publishers, 2010.
115. Quattrocchi U. *CRC World Dictionary of Medicinal and Poisonous Plants* (Vol. 2). Boca Raton, FL: CRC Press, 2012.
116. Wangchuk P *et al*. Pharmacological, ethnopharmacological, and botanical evaluation of subtropical medicinal plants of Lower Kheng region in Bhutan. *Integr Med Res* 2017; 6: 372–387.
117. Joshi R *et al*. Himalayan aromatic medicinal plants: a review of their ethnopharmacology, volatile phytochemistry, and biological activities. *Medicines* 2016; 3: 6.
118. Chinh HV *et al*. Essential oils leaf of *Cinnamomum glaucescens* and *Cinnamomum verum* from Vietnam. *Am J Plant Sci* 2017; 8: 2712.
119. Prakash B *et al*. Safety profile assessment and efficacy of chemically characterized *Cinnamomum glaucescens* essential oil against storage fungi, insect, aflatoxin secretion and as antioxidant. *Food Chem Toxicol* 2013; 53: 160–167.
120. Gyawali R *et al*. Antibacterial and cytotoxic activities of high altitude essential oils from Nepalese Himalaya. *J Med Plants Res* 2013; 7: 738–743.
121. Singh NP, Singh KP, Singh DK (2002). *Flora of Mizoram*, I. Kolkata, India: Botanical Survey of India
122. Satyal P *et al*. Bioactivities and compositional analyses of *Cinnamomum* essential oils from Nepal: *C. camphora, C. tamala,* and *C. glaucescens*. *Nat Prod Commun* 2013; 8: 1777–1784.
123. Adhikary SR *et al*. Investigation of Nepalese essential oils. I. The oil of *Cinnamomum glaucescens* (Sugandha Kokila). *J Essent Oil Res* 1992; 4: 151–159.
124. Kumar A *et al*. *Natural Economic Products: An Encyclopaedia*. New Delhi: Agri Horti Press, 2016.
125. Suhaimi AT *et al*. Essential oil chemical constituent analysis of *Cinnamomum iners*. *J Eng Appl Sci* 2017; 12: 5369–5372.
126. Espineli DL *et al*. Chemical constituents of *Cinnamomum iners*. *Chem Nat Compd* 2013; 49: 932–933.
127. Phutdhawong W *et al*. Microwave-assisted isolation of essential oil of *Cinnamomum iners* Reinw. ex Bl.: comparison with conventional hydrodistillation. *Molecules* 2007; 12: 868–877.
128. Mustaffa F *et al*. Analgesic activity, toxicity study and phytochemical screening of standardized *Cinnomomum iners* leaves methanolic extract. *Pharmacog Res* 2010; 2: 76–81.
129. Ghalib RM *et al*. Phytochemical analysis, cytotoxic activity and constituents–activity relationships of the leaves of *Cinnamomum iners* (Reinw. ex Blume-Lauraceae). *Nat Prod Res* 2012; 26: 2155–2158.
130. Lin CT *et al*. Bioactivity investigation of Lauraceae trees grown in Taiwan. *Pharm Biol* 2007; 45: 638–644.
131. Mustaffa F *et al*. *Cinnamomum iners* leaves as an alternative therapy for diabetes. *Asian J Biochem* 2016; 11: 44–52.
132. Mustaffa F *et al*. Antidiabetic and antihyperlipidemic potential of standardized extract, fraction and subfraction of *Cinnamomum iners* leaves. *Int J Pharm Pharm Sci* 2014; 6: 220–225.

133. Pang KL *et al*. *Cinnamomum iners* as mitogen-activated protein kinase kinase (MKK1) inhibitor. *Int J Eng Technol* 2009; 1: 310–313.
134. Butkhup L, Samappito S. In vitro free radical scavenging and antimicrobial activity of some selected Thai medicinal plants. *Res J Med Plant* 2011; 5: 254–265.
135. Vigila AG *et al*. In vitro antimicrobial activities of *Cinnamomum iners* leaf and bark extracts against pathogens of food borne diseases. *Approaches Poult Dairy Vet Sci* 2018; 3: 1–5.
136. Azmi NM. Antibacterial activity of Cinnamomum iners (Lauraceae) extracts, Bachelor's thesis. Universiti Malaysia Kelantan, Kota Bharu, Malaysia, 2016.
137. Udayaprakash NK *et al*. Antioxidant, free radical scavenging and GC–MS composition of *Cinnamomum iners* Reinw. ex Blume. *Ind Crops Prod* 2015; 69: 175–179.
138. Abdullah WO *et al*. In vitro antiplasmodial activity and cytotoxicity of ten plants used as traditional medicine in Malaysia. *Jurnal Sains Kesihatan Malaysia (Malays J Health Sci)* 2011; 9(2): 5–8.
139. Tan MSMZ *et al*. Inhibitory effect of selected Malaysian herbal plants on glutathione S-transferase activity. *Int J Pharmacol* 2011; 7: 349–355.
140. Mustaffa F *et al*. Antioxidant capacity and toxicity screening of *Cinnamomum iners* standardized leaves methanolic extract. *Int J Pharmacol* 2010; 6: 888–895.
141. Mustaffa F *et al*. An antimicrobial compound isolated from *Cinnamomum iners* leaves with activity against methicillin-resistant *Staphylococcus aureus*. *Molecules* 2011; 16: 3037–3047.
142. Ahmad FB, Holdsworth DK. Medicinal plants of Sarawak, Malaysia, Part I. The Kedayans. *Int J Pharmacogn* 1994; 32: 384–387.
143. Ramalingam K, Balasubramanian A. In-vitro anticancer activity of *Cinnamomum iners* Reinw. against DAL and EAC cell lines. *Ind J Appl Res* 2015; 5: 546–547.
144. Delang CO. The role of medicinal plants in the provision of health care in Lao PDR. *J Med Plants Res* 2007; 1: 050–059.
145. Das PR *et al*. A selection of medicinal plants used for treatment of diarrhea by folk medicinal practitioners of Bangladesh. *Am Eurasian J Sustain Agric* 2012; 6(3): 153–161.
146. Drury CH. *Ayurvedic Useful Plants of India: With Their Medicinal Properties and Uses in Commerce, Medicine and Arts*. New Delhi, India: Asiatic Publishing House, 2010.
147. Mustaffa F *et al*. Review on pharmacological activities of *Cinnamomum iners* Reinw. ex Blume. *Nat Prod Res* 2013; 27: 888–895.
148. Kraisintu K. The status of medicinal and aromatic plants in Cambodia, Laos, the Philippines, Thailand and Vietnam. In: *Medicinal Plants and Their Utilization*. Trieste, Italy: United Nations Industrial Development Organization and the International Centre for Science and High Technology, 2003: 3–54.
149. Bahekar S, Kale R, Nagpure S. A review on medicinal plants used in scorpion bite treatment in India. *Mintage J Pharm Med Sci* 2012; 1(1): 1–6.
150. Lingaraju DP *et al*. Ethnopharmacological survey of traditional medicinal plants in tribal areas of Kodagu district, Karnataka, India. *J Pharm Res* 2013; 6: 284–297.
151. Singh V, Jain AP. *Ethnobotany and Medicinal Plants of India & Nepal* (Vol. 2). Jodhpur, India: Scientific Publishers, 2003.
152. Wiart C. *Medicinal Plants of the Asia-Pacific: Drugs for the Future?* Singapore: World Scientific Publishing Company, 2006.
153. Darusman LK *et al*. Comparing medicinal plants use for traditional and modern herbal medicine in Long Nah Village of East Kalimantan. *Bionatura* 2014; 16(2): 95–102.
154. Lin CT *et al*. Anti-inflammation activity of fruit essential oil from *Cinnamomum insularimontanum* Hayata. *Biores Technol* 2008; 99: 8783–8787.
155. Hsieh TJ *et al*. Actinodaphnine induces apoptosis through increased nitric oxide, reactive oxygen species and down-regulation of NF-κB signaling in human hepatoma Mahlavu cells. *Food Chem Toxicol* 2006; 44: 344–354.
156. Lin CC *et al*. Anti-herpes virus type 2 activity of herbal medicines from Taiwan. *Pharm Biol* 2003; 41: 259–262.
157. Li TSC. *Taiwanese Native Medicinal Plants*. Boca Raton, FL: CRC Press, 2006.
158. Chang HS, Chen IS. Chemical constituents and bioactivity of Formosan lauraceous plants. *J Food Drug Anal* 2016; 24: 247–263.
159. Yuan W *et al*. Antimicrobial efficacy of *Cinnamomum javanicum* plant extract against *Listeria monocytogenes* and its application potential with smoked salmon. *Int J Food Microbiol* 2017; 260: 42–50.
160. Salleh WMNHW *et al*. Evaluation of antioxidant, anticholinesterase and antityrosinase activities of Malaysian *Cinnamomum* species. *Dhaka Univ J Pharm Sci* 2015; 14: 125–132.
161. Nagappan T *et al*. Diversity in volatile chemicals and antibacterial activity among selected genus of *Cinnamomum*, *Etlingera* and *Schizostachyum* from Sabah. *J Sustain Sci Manag* 2017; 12: 26–33.
162. Rizwana JN *et al*. A survey on phytochemical and bioactivity of plant extracts from Malaysian forest reserves. *J Med Plants Res* 2010; 4: 203–210.
163. Wardah FM, Setyowati FM.Medicinal Plant Biodiversity in Dayak Communities Living in Kahayan Hulu Utara, Gunung Mas Regency, Central Kalimantan. Proceedings of International Conference on Medicinal Plants, 503–512.
164. Ong HC *et al*. Traditional medicinal plants used by the temuan villagers in Kampung Tering, Negeri Sembilan, Malaysia. *Stud Ethno Med* 2011; 5: 169–173.
165. Lindley J. *Flora Medica: A Botanical Account of All the More Important Plants Used in Medicine, in Different*

Parts of the World. New York, NY: Cambridge University Press, 2011.
166. Buckingham J, Munasinghe VR. *Dictionary of Flavonoids with CD-ROM*. Boca Raton, FL: CRC Press, Taylor and Francis Group, LCC, 2015.
167. Kuo YC *et al*. Inhibitory effects of acylated kaempferol glycosides from the leaves of *Cinnamomum kotoense* on the proliferation of human peripheral blood mononuclear cells. *Planta Med* 2005; 71: 412–415.
168. Chen CH *et al*. Chemical and cytotoxic constituents from the leaves of *Cinnamomum kotoense*. *J Nat Prod* 2006; 69: 927–933.
169. Yang SS *et al*. A new γ-lactone from the leaves of *Cinnamomum kotoense*. *Nat Prod Res* 2006; 20: 1246–1250.
170. Chen CY *et al*. Anticancer activity of isoobtusilactone A from *Cinnamomum kotoense*: involvement of apoptosis, cell-cycle dysregulation, mitochondria regulation, and reactive oxygen species. *J Nat Prod* 2008; 71: 933–940.
171. Chen CY *et al*. Isoobtusilactone A-induced apoptosis in human hepatoma Hep G2 cells is mediated via increased NADPH oxidase-derived reactive oxygen species (ROS) production and the mitochondria-associated apoptotic mechanisms. *Food Chem Toxicol* 2007; 45: 1268–1276.
172. Cheng KC *et al*. Three novel antioxidants from *Cinnamomum* plants. *Afr J Biotech* 2012; 11: 4463–4466.
173. Chen FC *et al*. Antitubercular constituents from the stem wood of *Cinnamomum kotoense*. *J Nat Prod* 2005; 68: 1318–1323.
174. Lin YH *et al*. Enhancement of bone marrow-derived mesenchymal stem cell osteogenesis and new bone formation in rats by obtusilactone A. *Int J Mol Sci* 2017; 18: 2422.
175. Chen CY, Hong ZL. Chemical constituents from the fruits of *Cinnamomum kotoense*. *Chem Nat Compd* 2011; 47: 450–451.
176. Brophy JJ *et al*. The leaf oils of the Australian species of *Cinnamomum* (Lauraceae). *J Essent Oil Res* 2001; 13: 332–335.
177. Dong L *et al*. Anticancer agents from the Australian tropical rainforest: Spiroacetals EBC-23, 24, 25, 72, 73, 75 and 76. *Chem Eur J* 2009; 15: 11307–11318.
178. Lassak EV, McCarthy T. *Australian Medicinal Plants*. North Rhyde, Australia: Methuen Australia Pty Ltd., 2011.
179. Bhattacharjee SK. *Hand Book of Medicinal Plants* (4th edn). Jaipur, India: Pointer Publishers, 2004.
180. Khan IA *et al*. Evaluation of counter irritant potential of aqueos bark extract of *Cinnamon loureiroi*. *Int J Pharm Res Allied Sci* 2014; 3: 30–35.
181. Jiang ZT *et al*. Essential oil composition of *Cinnamomum loureiroi* grown in China extracted by supercritical fluid extraction. *J Essent Oil Bear Plant* 2008; 11: 267–270.
182. Ali M. *Text Book of Pharmacognosy*. New Delhi, India: CBS Publishers & Distributors, 1998.
183. Hong CH *et al*. Evaluation of natural products on inhibition of inducible cyclooxygenase (COX-2) and nitric oxide synthase (iNOS) in cultured mouse macrophage cells. *J Ethnopharmacol* 2002; 83: 153–159.
184. Silprasit K *et al*. Anti-HIV-1 reverse transcriptase activities of hexane extracts from some Asian medicinal plants. *J Med Plant Res* 2011; 5: 4899–4906.
185. Hrideek TK *et al*. Phytochemical profiling of bark and leaf volatile oil of two wild *Cinnamomum species* from evergreen forests of Western Ghats. *Plant Arch* 2016; 16: 266–274.
186. Salleh WM *et al*. Antioxidant and anticholinesterase activities of essential oils of *Cinnamomum griffithii* and *C. macrocarpum*. *Nat Prod Commun* 2015; 10: 1465–1468.
187. Prajapati ND, Kumar U. *Agro's: Dictionary of Medicinal Plants*. Jodhpur, India: Agrobios, 2003.
188. Chopra RN *et al*. *Glossary of Indian Medicinal Plants*. New Delhi, India: CSIR, 2002.
189. Agarwal VS. *Directory of Indian Economic Plants*. Dehradun, India: Bishen Singh Mahendra Pal Singh, 2003.
190. Torres RC *et al*. Phytochemical screening and biological studies on the crude methanol extract of *Cinnamomum* mercadoi Vidal. *Philippine J Sci*, 2003; 132: 27–32.
191. Gorgonio SRP, Fuentes RG. Antidiarrheal activity of *Cinnamomum* mercadoi methanolic leaf and bark extracts. *Philipp J Nat Sci* 2011; 16: 43-47.
192. Fuentes RG *et al*. Antioxidant and antibacterial properties of crude methanolic extracts of *Cinnamomum* mercadoi Vidal. *Philipp J Nat Sci* 2010; 15: 9–15.
193. Bandibas MB, Roxas P. Antimicrobial test of five ethnomedicinal plants in an ancestral forest area. *Glob J Environ Sci Manag* 2017; 3: 257–266.
194. Latayada FS, Uy MM. Screening of the antioxidant properties of the leaf extracts of Philippine medicinal plants *Ficus nota* (Blanco) Merr., *Metroxylon sagu* Rottb., *Mussaenda philippica* A. Rich., *Inocarpus fagifer*, and *Cinnamomum mercadoi* Vidal. *Bull Environ Pharmacol Life Sci* 2016; 5: 18–24.
195. Baruah A *et al*. Leaf and stem bark oils of *Cinnamomum sulphuratum* Nees from Northeast India. *J Essent Oil Res* 1999; 11: 194–196.
196. Lawrence BM, Hogg JW. The chemical composition of uncommon spices and condiments. *Planta Med* 1974; 25: 1–5.
197. Cheng SS *et al*. Chemical polymorphism and composition of leaf essential oils of *Cinnamomum kanehirae* using gas chromatography/mass spectrometry, cluster analysis, and principal component analysis. *J Wood Chem Technol* 2015; 35: 207–219.
198. Liu YK *et al*. Ethanol extracts of *Cinnamomum* kanehirai Hayata leaves induce apoptosis in human hepatoma cell through caspase-3 cascade. *Onco Targets Ther* 2015; 8: 99–109.
199. Leu YL *et al*. The chemical principles of the leaves of *Cinnamomum kanehirae* Hayata. *Planta Med* 2014; 80: P1L125.

200. Yeh RY *et al.* Evaluation of the antibacterial activity of leaf and twig extracts of stout camphor tree, *Cinnamomum* kanehirae, and the effects on immunity and disease resistance of white shrimp, *Litopenaeus vannamei*. *Fish Shellfish Immunol* 2009; 27: 26–32.
201. Jantan I, Goh SH. The essential oils of *Cinnamomum* mollissimum as natural sources of safrole and benzyl benzoate. *J Trop For Sci* 1990; 252–259.
202. Subki SY *et al.* Characterisation of leaf essential oils of three *Cinnamomum* species from Malaysia by gas chromatography and multivariate data analysis. *Pharmacogn J* 2013; 5: 22–29.
203. Jantan IB *et al.* Insecticidal activities of the leaf oils of eight *Cinnamomum* species against *Aedes aegypti* and *Aedes albopictus*. *Pharm Biol* 2005; 43: 526–532.
204. Cock IE *et al.* The potential of selected Australian medicinal plants with anti-proteus activity for the treatment and prevention of rheumatoid arthritis. *Pharmacogn Mag* 2015; 11: S190–S208.
205. Masnon FF. Phytochemicals and bioactivities of *Cinnamomum porrectum* (Roxb.) Kosterm and *Cinnamomum* mollissimum Hook F, Published Master's dissertation. University of Technology, Malaysia, 2014.
206. Hargreaves GW. LXIV.—the essential oil of *Cinnamomum* Oliveri (bail.) or brisbane sassafras. *J Chem Soc Trans* 1916; 109: 751–754.
207. Chikowe GR *et al.* *Cinnamomum* Oliveri FM Bailey leaf solvent extractions inhibit the growth of a panel of pathogenic bacteria. *Pharmacogn Commun* 2017; 7: 76–82.
208. Bellamy D, Pfister A. *World Medicine: Plants, Patients and People*. Cambridge, MA: Blackwell Publishers, 1992.
209. Tung YT *et al.* Anti-inflammation activities of essential oil and its constituents from indigenous cinnamon (*Cinnamomum osmophloeum*) twigs. *Biores Technol* 2008; 99: 3908–3913.
210. Lin HY, Chang ST. Kaempferol glycosides from the twigs of *Cinnamomum osmophloeum* and their nitric oxide production inhibitory activities. *Carbohyd Res* 2012; 364: 49–53.
211. Chen TH *et al.* Cytotoxic lignan esters from *Cinnamomum osmophloeum*. *Planta Med* 2010; 76: 613–619.
212. Lin GM *et al.* Antihyperglycemic activities of twig extract of indigenous cinnamon (*Cinnamomum osmophloeum*) on high-fat diet and streptozotocin-induced hyperglycemic rats. *J Sci Food Agric* 2018; 98: 5908–5915.
213. Lin GM *et al.* Antihyperglycemic and antioxidant activities of twig extract from *Cinnamomum osmophloeum*. *J Tradit Complement Med* 2016; 6: 281–288.
214. Lin TY *et al.* Antidyslipidemic activity of hot-water extracts from leaves of *Cinnamomum osmophloeum* Kaneh. *Phytother Res* 2011; 25: 1317–1322.
215. Rao YK *et al.* Evaluation of the anti-inflammatory and anti-proliferation tumoral cells activities of *Antrodia camphorata*, *Cordyceps sinensis*, and *Cinnamomum osmophloeum* bark extracts. *J Ethnopharmacol* 2007; 114: 78–85.
216. Chang CW *et al.* Antibacterial activities of plant essential oils against *Legionella pneumophila*. *Water Res* 2008; 42: 278–286.
217. Chang ST *et al.* Antibacterial activity of leaf essential oils and their constituents from *Cinnamomum osmophloeum*. *J Ethnopharmacol* 2001; 77: 123–127.
218. Lin GM *et al.* Structural characterization and bioactivity of proanthocyanidins from indigenous cinnamon (*Cinnamomum osmophloeum*). *J Sci Food Agric* 2016; 96: 4749–4759.
219. Yang L *et al.* Cinnamaldehyde attenuates pressure overload-induced cardiac hypertrophy. *Int J Clin Exp Pathol* 2015; 8: 14345–14354.
220. Lee SC *et al.* Inhibitory effect of *Cinnamomum osmophloeum* Kanehira ethanol extracts on melanin synthesis via repression of tyrosinase expression. *J Biosci Bioeng* 2016; 122: 263–269.
221. Wen TC *et al.* Effect of *Cinnamomum osmophloeum* Kanehira leaf aqueous extract on dermal papilla cell proliferation and hair growth. *Cell Transplant* 2018; 27: 256–263.
222. Tung YT *et al.* Bioactive phytochemicals of leaf essential oils of *Cinnamomum osmophloeum* prevent lipopolysaccharide/D-galactosamine (LPS/D-GalN)-induced acute hepatitis in mice. *J Agric Food Chem* 2011; 59: 8117–8123.
223. Cheng BH *et al.* Hypolipidemic effects of S-(+)-linalool and essential oil from *Cinnamomum osmophloeum* ct. linalool leaves in mice. *J Tradit Complement Med* 2018; 8: 46–52.
224. Wang SY *et al.* Essential oil from leaves of *Cinnamomum osmophloeum* acts as a xanthine oxidase inhibitor and reduces the serum uric acid levels in oxonate-induced mice. *Phytomedicine* 2008; 15: 940–945.
225. Lin SSC *et al.* In vivo cytokine modulatory effects of cinnamaldehyde, the major constituent of leaf essential oil from *Cinnamomum osmophloeum* Kaneh. *Phytother Res* 2011; 25: 1511–1518.
226. Lee SC *et al.* Chemical composition and hypoglycemic and pancreas-protective effect of leaf essential oil from indigenous cinnamon (*Cinnamomum osmophloeum* Kanehira). *J Agric Food Chem* 2013; 61: 4905–4913.
227. Lee MG *et al.* Evaluation of *Cinnamomum osmophloeum* Kanehira extracts on tyrosinase suppressor, wound repair promoter, and antioxidant. *Scientific World J* 2015; 2015: 1–7.
228. Lee SC *et al.* Anti-inflammatory effect of cinnamaldehyde and linalool from the leaf essential oil of *Cinnamomum osmophloeum* Kanehira in endotoxin-induced mice. *J Food Drug Anal* 2018; 26: 211–220.
229. Fang JM *et al.* Quantitative analysis of the essential oil of *Cinnamomum osmophloeum* Kanehira. *J Agric Food Chem* 1989; 37: 744–746.
230. Lee SC *et al.* DNA barcoding *Cinnamomum osmophloeum* Kaneh.

Based on the partial non-coding ITS2 region of ribosomal genes. *J Food & Drug Anal* 2010; 18(2): 128–135.
231. Huang TC *et al*. Induction of apoptosis by cinnamaldehyde from indigenous cinnamon *Cinnamomum osmophloeum* Kaneh through reactive oxygen species production, glutathione depletion, and caspase activation in human leukemia K562 cells. *Food Chem* 2007; 103: 434–443.
232. Lin YL *et al*. Characterization of S-(+)-linalool synthase from several provenances of *Cinnamomum osmophloeum*. *Tree Genet Genomes* 2014; 10: 75–86.
233. Chen CY *et al*. Substituent chemical shift of rhamnosides from the stems of *Cinnamomum osmophleum*. *Chin Pharm J* 2004; 56: 141–146.
234. Dũng NX *et al*. Constituents of the essential oils of *Cinnamomum parthenoxylon* (Jack) Nees from Vietnam. *J Essent Oil Res* 1995; 7: 53–56.
235. Jia Q *et al*. Hypoglycemic activity of a polyphenolic oligomer-rich extract of *Cinnamomum parthenoxylon* bark in normal and streptozotocin-induced diabetic rats. *Phytomedicine* 2009; 16: 744–750.
236. Pukdeekumjorn P *et al*. Anti-inflammatory activities of extracts of *Cinnamomum porrectum* (Roxb.) Kosterm. wood (Thep-tha-ro). *J Med Assoc Thai* 2016; 99: S138–S143.
237. Adfa M *et al*. Antileukemic activity of lignans and phenylpropanoids of *Cinnamomum parthenoxylon*. *Bioorg Med Chem Lett* 2016; 26: 761–764.
238. Uthairatsamee S, Wiwat C, Soonthornchareonnon N. A Comparison of antioxidant and antibacterial activities of crude extracts from various parts of *Cinnamomum porrectum* (Roxb.) Kosterm. In FORTROP II: Tropical Forestry Change in a Changing World. Conference conducted at Kasetsart University, Bangkok, Thailand
239. Farah HS*et al*. Biological activities of aqueous extract from *Cinnamomum porrectum*. In AIP Conference Proceedings, 1571, 250–253.
240. Pardede A *et al*. Flavonoid rutinosides from *Cinnamomum parthenoxylon* leaves and their hepatoprotective and antioxidant activity. *Med Chem Res* 2017; 26: 2074–2079.
241. Li XD *et al*. Purification of a new ribosome-inactivating protein from the seeds of *Cinnamomum porrectum* and characterization of the RNA N-glycosidase activity of the toxic protein. *Bio Chem Hoppe-Seyler* 1996; 377: 825–832.
242. Zheng XL, Xing FW. Ethnobotanical study on medicinal plants around Mt.Yinggeling, Hainan Island, China. *J Ethnopharmacol* 2009; 124: 197–210.
243. Sein CC, Mitlöhner R. *Cinnamomum parthenoxylon (Jack) Meisn: ecology and silviculture in Vietnam*. Bogor, Indonesia: CIFOR, 2011.
244. Chen P *et al*. Ethnobotanical study of medicinal plants on arthritis used by Chaoshan in Guangdong, China. *Med Chem (Los Angeles)* 2016; 6: 715–723.
245. Buru AS *et al*. In vitro antibacterial effects of *Cinnamomum* extracts on common bacteria found in wound infections with emphasis on methicillin-resistant *Staphylococcus aureus*. *J Ethnopharmacol* 2014; 153: 587–595.
246. Wei X *et al*. Chemical constituents from the leaves of *Cinnamomum parthenoxylon* (Jack) Meisn. (Lauraceae). *Biochem Syst Ecol* 2017; 70: 95–98.
247. Sukcharoen O *et al*. Control of aflatoxigenic strains by *Cinnamomum porrectum* essential oil. *J Food Sci Technol* 2017; 54: 2929–2935.
248. Kitirattrakarn T, Anantachoke C. Herbs from Peat Swamp Forests in Narathivas, Thailand. In III WOCMAP Congress on Medicinal and Aromatic Plants-Volume 6: Traditional Medicine and Nutraceuticals, 680, 73–81.
249. Jantan I *et al*. A comparative study of the constituents of the essential oils of three *Cinnamomum* species from Malaysia. *J Essent Oil Res* 2003; 15: 387–391.
250. Jantan IB *et al*. Constituents of the essential oils of *Cinnamomum sintoc* Blume from a mountain forest of Peninsular Malaysia. *Flavour Fragr J* 2005; 20: 601–604.
251. Sumiwi SA *et al*. Analysis of chemical composition and its analgesic and anti-inflammatory activity of essential oil of sintoc bark (*Cinnamomum sintoc* bl.) using in vivo methods. *J Appl Pharm Sci* 2015; 5: 058–065.
252. Pratiwi SUT *et al*. Antimicrobial effects of Indonesian medicinal plants extracts on planktonic and biofilm growth of *Pseudomonas aeruginosa* and *Staphylococcus aureus*. *J Hort* 2015; 2: 1–14.
253. Globinmed.com (2019). Globinmed – Cinnamomum sintoc Blume. http://www.globinmed.com/index.php?option=com_content&view=article&xml:id=106104:Cinnamomum-sintoc-blume-106104&catxml:id=286&Itemxml:id=357#r10 (accessed 24 January 2019).
254. Iskandar Y, Mustarichie R. Determination and identification of chemical compounds from ethyl acetate fraction of the stem bark of sintok (*Cinnamomum sintoc* Bl.). *J Pharm Res* 2018; 12: 606.
255. Chen CY *et al*. Chemical constituents from the roots of *Cinnamomum subavenium*. *Chem Nat Compd* 2010; 46: 474–477.
256. Chen CY *et al*. A novel sesquiterpenoid from the roots of *Cinnamomum subavenium*. *Nat Prod Res* 2010; 24: 423–427.
257. Chen CY *et al*. Cytotoxic constituents of the stems of *Cinnamomum subavenium*. *J Nat Prod* 2007; 70: 103–106.
258. Wang HM *et al*. Identifying melanogenesis inhibitors from *Cinnamomum subavenium* with in vitro and in vivo screening systems by targeting the human tyrosinase. *Exp Dermatol* 2011; 20: 242–248.
259. Lin HC, Lee SS. Dibenzocycloheptanoids from the leaves of *Cinnamomum subavenium*. *J Nat Prod* 2012; 75(10): 1735–1743.
260. Liu CH *et al*. Subamolide A, a component isolated from *Cinnamomum subavenium*, induces apoptosis mediated by mitochondria-dependent, p53 and ERK1/2 pathways in human urothelial carcinoma cell line NTUB1. *J Ethnopharmacol* 2011; 137: 503–511.

261. Hao X *et al*. Chemical constituents from leaves of *Cinnamomum subavenium*. *Biochem Syst Ecol* 2015; 61: 156–160.
262. Jantan IB *et al*. Constituents of the leaf and bark oils of *Cinnamomum subavenium* Miq. *J Essent Oil Res* 2005; 17: 281–283.
263. Lin RJ *et al*. A novel cytotoxic monoterpenoid from the leaves of *Cinnamomum subavenium*. *Nat Prod Res* 2008; 22: 1055–1059.
264. Rameshkumar KB, George V. *Cinnamomum sulphuratum* Nees—a Benzyl Benzoate-Rich New Chemotype from Southern Western Ghats, India. *J Essent Oil Res* 2006; 18: 521–522.
265. Pullaiah T. *Encyclopaedia of World Medicinal Plants* (Vol. 2). New Delhi, India: Regency Publication, 2006.
266. Kumar KNS *et al*. Chemical fingerprint of leaves of *Cinnamomum sulphuratum* Nees growing in Kodagu, Karnataka. *J Pharmacogn Phytochem* 2013; 2: 163–168.
267. Maridass M. Anti-Inflammatory activity of the methanolic extract of *Cinnamomum sulphuratum* barks. *Ethnobotanical Leaflets* 2008; 12: 494–498.
268. Maridass M. Screening of antifungal activities of barks of *Cinnamomum* species. *Thai J Pharm Sci* 2009; 33: 137–143.
269. Lakshmana Ashwini AH *et al*. An Ethnobotanical survey of wild aromatic medicinal plants of Davanagere District, Karnataka State India. *Int J Adv Res*2015; 3: 1285–1296.
270. Sharma GD, Deorani SC. *Medicinal Plants of Nagaland*. Dehradun, India: Bishen Singh Mahendra Pal Singh, 2007.
271. Pullaiah T, Naidu KC. *Antidiabetic Plants in India and Herbal Based Antidiabetic Research*. New Delhi, India: Regency Publication, 2003.
272. Shivaprasad D. (2015). Reproductive biology of *Cinnamomum sulphuratum* Nees. From wet evergreen forest of Western Ghats in Karnataka. Proceedings of the International Academy of Ecology and Environmental Sciences, 5, 7.
273. Cheng MJ *et al*. Isolation of a nitrobenzoate from the leaves of *Cinnamomum tenuifolium*. *Nat Prod Res* 2011; 25: 118–122.
274. Chen HL *et al*. A new benzodioxocinone from the leaves of *Cinnamomum tenuifolium*. *Nat Prod Res* 2012; 26: 1881–1886.
275. Peng YH *et al*. Chemical composition and repellency of *Cinnamomum japonicum* leaf-derived essential oil against *Aedes albopictus*. In :*Applied Mechanics and Materials*. XX: Trans Tech Publications, 2013; 295: 35–38.
276. Fujita Y *et al*. Biogenesis of the essential oils in camphor trees. XXVIII. On the components of the essential oil of *Cinnamomum japonicum* Sieb. *Bull Chem Soc Jpn* 1971; 44: 784–786.
277. Seo EJ *et al*. Antiangiogenic activity and pharmacogenomics of medicinal plants from traditional Korean medicine. *Evid Based Complement Alternat Med* 2013; 2013: 1–13.
278. Lin RJ *et al*. Cytotoxic compounds from the stems of *Cinnamomum tenuifolium*. *J Nat Prod* 2009; 72: 1816–1824.
279. Ma YZ *et al*. Inhibitory activity of essential oils from *Cinnamomum camphora* and *Cinnamomum japonicum* leaves. *J Central South Univ For Technol* 2009; 1: 009.
280. Koa EY *et al*. Evaluation on antioxidant properties of sixteen plant species from Jeju island in Korea. *EXCLI J* 2015; 14: 133–145.
281. Dong HP *et al*. The effect of butanolides from *Cinnamomum tenuifolium* on platelet aggregation. *Molecules* 2013; 18: 11836–11841.
282. Temperate.theferns.info. (2019). *Cinnamomum japonicum* – useful Temperate Plants. http://temperate.theferns.info/plant/Cinnamomum+japonicum (accessed 25 January2019).
283. Tripathi IP, ed. *Chemistry, Biochemistry and Ayurveda of Indian Medicinal Plants*. Indore, India: International E Publication, 2010.
284. Nath SC *et al*. Chemical composition of the leaf essential oil of *Cinnamomum pauciflorum* Nees. *Flavour Frag J* 2006; 21: 531–533.
285. Prasad KN *et al*. Flavonoid contents and antioxidant activities from *Cinnamomum* species. *Innov Food Sci Emerg Technol* 2009; 10: 627–632.
286. Mir AH *et al*. Diversity of endemic and threatened ethnomedicinal plant species in Meghalaya, North-East India. *Int Res J Environ Sci* 2014; 3: 64–78.
287. Sriramavaratharajan V, Murugan R. Chemical profile of leaf essential oil of *Cinnamomum walaiwarense* and comparison of its antioxidant and hypoglycemic activities with the major constituent benzyl benzoate. *Nat Prod Commun* 2018; 13: 779–782.
288. Tropical.theferns.info. (2019). Cinnamomum walaiwarense - Useful Tropical Plants. http://tropical.theferns.info/viewtropical.php?xml:id=Cinnamomum+walaiwarense (accessed 25 Januaty 2019).
289. Raghavan GV. *Comprehensive Medicinal Plants*. Studium Press LLC2011; 2: 239–240.
290. Laloo D, Sahu AN. Antioxidant activities of three Indian commercially available Nagakesar: an in vitro study. *J Chem Pharm Res* 2011; 3: 277–283.
291. Deepalakshmi S, Jeyabalan D. Studies on Mosquitocidal and biological activity of endemic plants of Nilgiris Hills against filarial vector, Culex quinquefasciatus (Say)(Insecta: Diptera: Culicidae). *Int J Advanced Res Biol Sci* 2017; 4: 137–151.
292. Deshpande DJ. *A Hand Book of Medicinal Herbs: A Source Book of Herbal Remedies, Chemical Constituents, Biological Activities and Usage*. Jodhpur, India: Agrobios, 2010.
293. Tropical.theferns.info. (2019). *Cinnamomum wightii* – Useful Tropical Plants. http://tropical.theferns.info/viewtropical.php?xml:id=Cinnamomumwightii (accessed 25 January 2019).
294. Anil Kumar K, Shivaraju H. A study on traditional knowledge and medicinal applications of the endemic herbal species in the Western Ghats of Shimoga Region, Karnataka, India. *Int J Res Chem Environ* 2016; 2: 1–13.
295. Tropical.theferns.info. (2019). *Cinnamomum wilsonii* – Useful Tropical

Plants. http://tropical.theferns.info/viewtropical.php?xml:id=%20Cinnamomum%20wilsonii (accessed 25 January 2019).
296. Shu P *et al*. Wilsonols A-L, megastigmane sesquiterpenoids from the leaves of *Cinnamomum wilsonii*. *J Nat Prod* 2013; 76: 1303–1312.
297. Jiao-juan LI *et al*. Scavenging of DPPH radical by total flavonoids extracted from leaves of *Cinnamomum wilsonii* Gamble. *J Central South Univ For Technol* 2010; 10: 024.

Supporting Information

Additional Supporting Information may be found in the online version of this article:

Figure S1. Benefits of cinnamon.