Significance of gingers (Zingiberaceae) in Indian System of Medicine - Ayurveda: An overview

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ABSTRACT

Background: Family Zingiberaceae consists of the large number of medicinal plants and is well-known for its use in ethnomedicine and play a major role in Indian System of Medicine, Ayurveda.

Objective: The aim of this study is the documentation of Zingiberaceous plants used in Ayurveda, adding information to the systematics, vernacular names and chemistry with experimental data.

Materials and Methods: The live plants were collected from wild and successfully conserved at Herbal Garden of Arya Vaidya Sala, Kottakkal. The experimental data of each species has been collected from the various sources. The photographs were taken and all relevant data documented.

Results and Conclusion: A total of 13 species belonging to 7 genera of Zingiberaceae were documented. The work will be useful to students and researchers as it provides an easy access to Zingiberaceous plants used in Ayurveda.

KEY WORDS: Ayurveda, *Curcuma*, Gingers, Indian System of Medicine, Zingiberaceae

INTRODUCTION

The family Zingiberaceae is well-known for its medicinal values and it is distributed widely throughout the tropics, particularly in Southeast Asia. Gingers are important natural resources, which provide many useful products for food, spices, medicines, dyes, perfume etc.[1] The ginger family consists of 53 genera and over 1200 species.[2] India is one of the richest and diverse regions for Zingiberaceae, having 20 genera and around more than 200 species.[3] The members of Zingiberaceae are annual or perennial rhizomatous herbs. The rhizome is sympodially branched and composed of distinct segments.[4] The rhizomes are variously colored ranging from pale yellow, deep yellow, greenish blue, pink or combinations of these in different species. The young rhizomes and axillary buds are protected by scale leaves. Leafy shoots are generally unbranched and true aerial stem is present in some genera and absent in others. True stem is very short as in *Kaempferia* or pseudostem with clasping leaf sheaths as in *Curcuma*. The leaves are distichous and they exhibit morphological variation in structure, shape, size, texture and venation.[3]

Leaves distichously arranged transverse or parallel to rhizome, aromatic oil cells present. Labellum small or large, showy. Lateral staminodes mostly present. Filament narrow, long, exserted. Epigynous glands usually two, linear, or rarely absent. Ovary unilocular or trilocular. The important genera having medicinal uses coming under Zingiberaceae are *Alpinia*, *Amomum*, *Curcuma*, *Elettaria*, *Hedychium*, *Kaempferia* and *Zingiber*.[5]

The plants are characterized by the presence of volatile oils and oleoresins of export value. In general, the rhizomes and fruits are aromatic, tonic and stimulant. Some are used as food as they contain starch in large quantities while others yield an astringent and diaphoretic juice.

MATERIALS AND METHODS

The live plants were collected and successfully conserved at Herbal Garden of Arya Vaidya Sala, Kottakkal and Calicut University Botanical Garden for further studies. Detailed literature survey has pointed out that there are numerous Zingiberaceous plants described for treatment of many diseases and herbal medicine and they play a major role

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in the preparation of many Ayurvedic drugs. Literature was collected from different sources such as Ayurvedic classical texts, Floras, books, journals, internet databases etc., to make a list of medicinal plants classified under Zingiberaceae.

RESULTS AND DISCUSSION

The study documented 13 ginger species mainly used in Ayurveda viz., *Alpinia calcarata* (Haw.) Roscoe, *A. galanga* (L.) Retz., *Amomum subulatum* Roxb., *Curcuma angustifolia* Roxb., *C. amada* Roxb., *C. aromatica* Salisb., *C. zedoaria* (Christm.) Roscoe, *C. longa* L., *Elettaria cardamomum* (L.) Maton, *Hedychium spicatum* Buch.-Ham. Ex J.E. Sm., *Kaempferia galanga* L., *K. rotunda* L. and *Zingiber officinale* Roscoe.

Alpinia Roxb

The generic name commemorates Prospero Alpini (1533-1617), an Italian Botanist, Physician to the Prince of Melfi and Professor of Botany at the University of Padua. The tropical and subtropical genus, *Alpinia* Roxb., with about 230 species, is mainly distributed in the Indo-Pacific region.[3] Due to the presence of essential oil, the rhizomes are used in bronchial troubles and as a carminative. It is one of the ingredients of medicated "*Pān*" used for removing the foul smell of the mouth and getting relief in throat inflammation.[6] In Ayurveda, "*Rāsnā saptaka kvātham*" and "*Rāsnā -adikāmath*" are used as anti-inflammatory decoctions. It is also used in "*Arq Pan*" as a cardiac stimulant carminative.[7] They are also useful in vitiated conditions of *vāta* and *kapha*, rheumatoid arthritis, inflammations, stomatopathy, pharyngopathy, cough, asthma, hiccough, dyspepsia, stomachalgia, obesity, diabetes, cephalalgia, tubercular glands and intermittent fevers.[6] Caraka includes *Rāsnā* (*Alpinia*) in the *Vayaḥsthāpana Varga*, the group of drugs that are capable of maintaining the youthful vigour and strength.[8]

Alpinia calcarata (Haw.) Roscoe

Leafy stem up to 1.5 m high. Leaves sessile, lamina glabrous, linear-lanceolate. Ligule membraneous, bifid. Inflorescence terminal, 10-15 cm long, peduncle densely pubescent. Bracts minute, triangular, pubescent. Flowers shortly pedicellate, calyx tubular. Corolla tube almost equal to the calyx, lobes oblong. Labellum obovate, variegated with dark purple and yellow, glabrous. Stamen shorter than labellum, anther thecae parallel, pubescent. Epigynous glands two, free from each other. Ovary trilocular with many ovules. Fruit globose, orange-red, seeds many [Figure 1a-c].

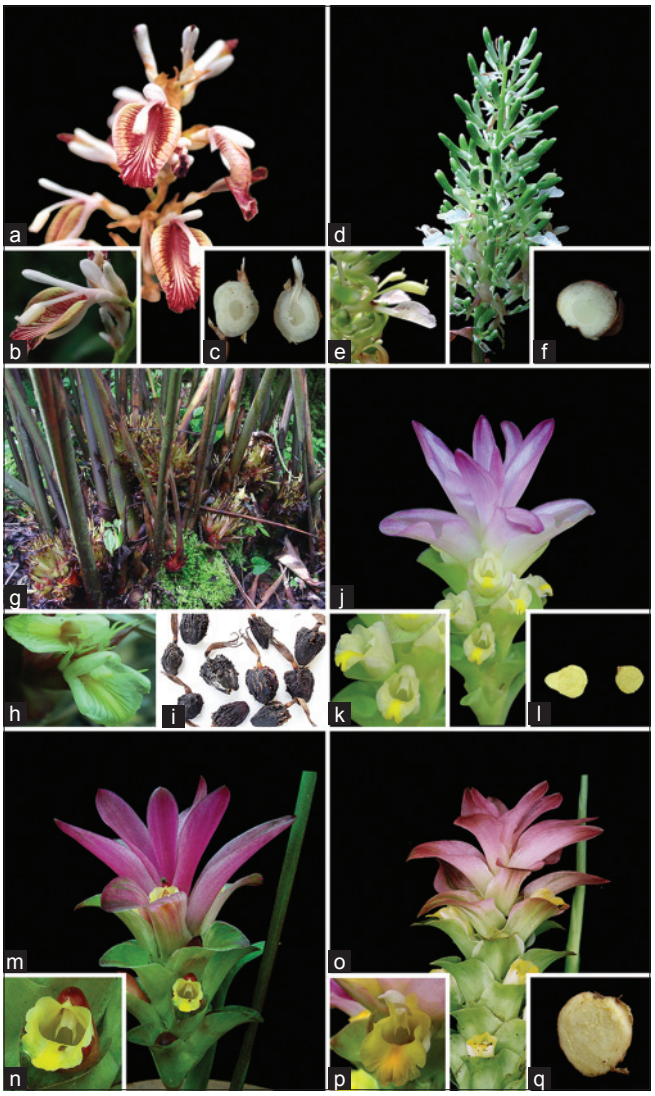

Figure 1: (Insight: Close-up of flower and c.s. of rhizome/fruits). (a-c) *Alpinia calcarata* (Haw.) Roscoe; (d-f) *A. galanga* (L.) Retz.; (g-i) *Amomum subulatum* Roxb.; (j-l) *Curcuma angustifolia* Roxb.; (m and n) *C. amada* Roxb.; (o-q) *C. aromatica* Salisb

The officinal part is the rhizome which forms a major ingredient of preparations like *Rāsnādi Kaṣāya, Rāsnādi cūrṇa, Rāsnādi tailam, Aśvagandhāriṣṭam* etc.[9] The drug stimulates digestion, purifies blood and improves voice.[10] Rhizomes of *Alpinia calcarata* possess several bioactivities. The rhizomes of *A. calcarata* are anti-inflammatory.[11]

A study found the cytotoxic activity of ethanol extract of *Alpinia calcarata*, the rhizome, against Ehrlich ascites carcinoma tumor bearing Swiss Albino mice and concluded that the plant rhizome can be considered as a probable new source of antitumor agents.[12] There is a report that the antinociceptive effect and gastroprotective activity

was slightly higher in hot ethanol extract than hot water extract of rhizomes.[13] The constituents of the essential oil of rhizomes, roots and leaves were analyzed by Gas chromatography/mass spectrometry (GC/MS) and 18 compounds were identified. Four new labdane-type diterpenoids, calcaratarins A-D (1-4), along with six known labdane-type diterpenoids, an elemane-type sesquiterpenoid and a coumarin, were isolated. The major compound in the rhizome and leaf oils was 1,8-cineole (33.3%), whereas in the root oil, it was α-fenchyl acetate (39.8%).[14] The physiochemical characteristics of the essential oils from leaves and roots of *A. calcarata* have been described.[15]

A. galanga (L.) Retz

Aromatic perennial herb over 2 m high. Leaves large, oblong-lanceolate. Petiole short, pubescent. Ligule entire, hairy. Inflorescence terminal, 25-30 cm long, peduncle densely pubescent. Bracts membranous and deciduous. Flower pedicellate, calyx cylindrical, greenish-white. Labellum ungiculate in the lower half, white with a few oblique lilac lines on either side of the midrib. Anther thecae light green to yellow. Epigynous glands irregularly lobed with rounded apices. Ovary ellipsoid. Fruit globose, seeds few [Figure 1d-f].

The rhizomes are bitter, acrid, thermogenic, aromatic, nervine tonic, stimulant, revulsive, carminative, stomachic, disinfectant, aphrodisiac, expectorant, broncho-dilator, antifungal, febrifuge, anti-inflammatory and tonic.[6] The rhizome is stimulant, carminative and laxative and is useful in flatulence, dyspepsia, vomiting and sickness of the stomach.[16] Steam inhaled with the vapours of the volatile oil of this rhizome stimulates bronchial glands.[17] Intravenous injection of a small dose of tincture or an infusion of *A. galanga* indused a sharp fall in blood pressure in experimental animals. The blood pressure however comes to normal in a short time.[18]

The pharmacognosy and toxicology of anti-carcinogenic natural products from *A. galanga* root oil have been studied.[19] The effect of *A. galanga* on cytological and biochemical changes induced by cyclophosphamide in mice.[20] Seeds of this species contain phytochemicals such as 1′-acetoxychavicol acetate and 1′-acetoxy eugenol acetate, caryophyllenols I and II, n-pentadecane, 7-heptadecane and fatty acid methyl esters. Rhizomes yielded essential oil containing methyl cinnamate, cineole and d-pinene and sesquiterpenoids. Fresh rhizome yielded 18 monoterpenoids of which a-pinene, b-pinene and limonene are major compounds and 17 oxygen containing monoterpenoids with cineol, terpinen-4-o1 and a-terpineol are minor compounds.[21] The rhizome contains tannins and flavonoids, some of which have been identified as kaempferide, galangin and alpinin.[22] The oil contains 48% methyl cinnamate, 20-30% cineole, camphor and probably a-pinene.[17] Itokawa *et al*.[23] isolated two anti-tumor principles from *A. galanga*. Fourteen flavanoids were detected by chromatography of which seven were identified as quercetin-3-methyl ether, iso-rhamnetin, kaempferide, galangin and its 3-methyl ether; 11-acetoxy chavicol acetate (I) and 11-acetoxcy eugenol acetate (II) isolated from seeds along with caryophyllene oxide, caryophyllenol II, pentadecane and 7-heptadecane.[24]

Amomum Roxb

The name *Amomum* is derived from the Greek word *ammos* meaning, *a* = not and *momos* = impurity; an allusion to its use as an antidote for poison. *Amomum* is the second largest genus after *Alpinia* within Zingiberaceae with about 150-180 species, widely distributed in Southeast Asia.[25] In India, the genus is represented by 22 species, mostly restricted to North-Eastern India and Southern India.[26] The seeds and essential oil from seeds of many species are extensively used. Medicinally the seeds are credited with stimulant, stomachic, alexipharmic and astringent properties.

A. subulatum Roxb

Leaves simple, alternate, lamina oblong-lanceolate, petiole grooved above. Ligule deeply emarginated. Spike 6-12 cm long. Flower yellow, bract broadly obovate, green to pink. Bracteole obovate or spathiform. Calyx cylindric, tubular. Corolla tube shorter than lobes, pink-yellow, dorsal lobe obovate-oblong, lateral lobe oblanceolate. Labellum oblong, dark yellow. Lateral staminodes base slightly bulbous, hairy. Anther thecae oblong, epigynous glands yellow, warted. Ovary barrel-shaped, ovules many. Stigma subglobose. Fruit a capsule, seeds black, arillate [Figure 1g-i].

Medicinally the seeds are credited with stimulant, stomachic, alexipharmic and astringent properties. The seeds are also useful in vitiated conditions of *kapha* and *vāta*, halitosis, anorexia, dyspepsia, colic, flatulence, dysentery, cough, bronchitis, pruritus, liver congestion, hyperdepsia and gonorrhea.[6] The pod is used for eye inflammation, kidney and urinary disorder, infection of teeth, prevents and treats throat trouble, congestion of lung and pulmonary tuberculosis, asthma, heart disease, digestive disorder, cold, bladder disease, snake bite, scorpion bite, masticatory.[27] In affections of the teeth and gums, a decoction of the seeds is used as a gargle.[8] *A. subulatum* showed complete inhibition (100%) of *Aspergillus flavus* at 300 ppm.[28]

The seeds of *A. subulatum* are a rich source of essential oil.[29] The composition of the oil has been studied to obtain 1,8-cineole (74%) and limonene (10.3%) as major components along with several minor mono-and sesquiterpenoids.[30] The extract of the seeds has also been reported to afford a few glycosides, viz., subulin, petunidin-3,5-diglucoside, leucocyanadin-3-O-D-glucopyranoside along with cardamom and alpinetin.[31,32] Its seed oil was found to be highly active against the growth of keratinophhilic fungi.[33] The seeds contain a chalcone-cardamonin and a flavone-alpinetin. The glycosides-petunidin-3,5-diglucoside, leucocyanidin-3-O-D-glucopyranoside and subulin. Seeds on steam distillation yield an essential oil containing cineole as the principal constituent. Other constituents include pinene, sabinene, p-cymene, terpinen-4-ol, terpineol, nerolidol, terpinene, terpinyl acetate and bisabolene.[21,34] A new aurone glycoside-subulin was isolated from seeds.[24] Half-sib progeny analysis for variability, association among capsule traits and path coefficient analysis among components of essential oil in large cardamom were done by Karibasappa *et al*.[35] The seed mass weight, shell weight, mature seed index, total soluble solids of seed mucilage, seeds/capsules and total anthocyanins had high positive direct effect on oleoresin content and negative direct effect towards cineole component.

Curcuma L.

The name *Curcuma* originates from the Arabic word "kurkum", meaning yellow, which probably refers to the color of the rhizome or the flowers. The genus *Curcuma*, with around 120 species[36] is distributed in tropical and subtropical Asia. Its rhizomes yield curcumin and also aromatic oils, mainly used as a condiment. Farrel[37] states that turmeric is being used since the historic times as a dye, medicine, ceremonial color and as a magical symbol. In India, ladies anoint their bodies with turmeric paste, which is an antiseptic. Turmeric dye is used in combination with alkalies to color silk and cotton. It is also used in several countries as a coloring material in pharmacy, confectionery and food industries. It is an essential and sacred ingredient of all social, cultural and religious functions and rites in India, especially in the South.[38] Kirtikar and Basu[39] state that the rhizome is very pungent, bitter, healing, laxative, anthelmentic, vulnerary, tonic, alexeteric and emollient. It is used as medicine in various *kapha* and *vāta* diseases of the blood. On the whole it is used in the treatment of bronchitis, dropsy, vertigo, skin diseases, liver infections, burns, boils, elephantiasis, sprains, hysteric effects, fevers, swellings, chronic gonorrhea, bruises, small pox, chicken pox, scorpion snake and leech bites, congestions, scabies, dyspepsia, ring worm, etc.[40] The important *Curcuma* species used for the preparation of Ayurvedic raw drugs are *C. amada, C. angustifolia*, *C. aromatic*, *C. longa* and *C. zeodaria*

C. amada Roxb

Rhizome light yellow inside, white towards the periphery with the smell of green mango. Root tubers absent. Lamina oblong, lanceolate. Inflorescence lateral or central. Coma bracts violet and fertile bracts green. Flowers longer than bracts. Calyx truncate. Corolla tube funnel shaped, pale yellow, lobes unequal, white. Labellum somewhat elliptic, 3 lobed, midlobe emarginte. Stamen white, epigynous glands linear. Ovary trigonous, ovules many. Seed setting not common [Figure 1j-l].

The specific epithet amada is derived from Bengali meaning mango ginger referring to the rhizome having characteristic taste of unripe mango.[41] They were copiously used in Ayurveda and other traditional medicine,[42] dating back to Caraka Samhita.[43] The rhizomes are bitter, sweet sour, aromatic, cooling, appetizer, carminative, digestive, stomachic, demulcent, vulnerary, febrifuge, alexertic, aphrodisiac, laxative, diuretic, expectorant, anti-inflammatory and antipyretic.[6] Rhizome is CNS active, hypothermic and it shows potentiation of amphetamine toxicity. Tuber is trypsin inhibitor and is effective against *Vibrio cholerae*.[21] Which is also useful in vitiated conditions of *pitta*, anorexia, dyspepsia, flatulence, colic, bruises, wounds, chronic ulcers, skin diseases, pruritus, fever, constipations, strangury, hiccough, cough, bronchitis, sprains, gout, halitosis, otalgia and inflammations. Chemical investigation of the volatile oils of *Curcuma amada* (rhizome) had done by Gas Chromatography (GC) and Gas Chromatography Mass Spectrometry (GC/MS). The rhizome oil of *C. amada* had found chemical constituents such as myrcene (80.54%), β-pinene (4.64%), *C. zedoaria*, 1,8 cineol (18.5%), cymene (18.42%) and α-phellandrene (14.9%).[44]

C. angustifolia Roxb

Leaves elliptic, sheath keeled, glabrous, ligule membranous, acute, glabrous. Spike terminal, bracts obovate, obtuse and thinly pubescent. Flowers yellowish-white; calyx lobes truncate, glabrous. Corolla unequal, larger lobes oblong, obtuse to shortly bifid at apex, lip obovate, deeply divided above, yellow. Staminodes obovate, entire, anthers spur divaricating, connective shortly producing; ovary pubescent [Figure 1m and n].

Demulcent, antipyretic, effective against gravel Stomatitis, and aids in blood coagulation.[45] The rhizome essential oils of *C. angustifolia* were subjected to GC (MS) analysis, which resulted in the identification of 81 and 78 constituents. The

major constituents in the rhizome oil from central India were xanthorrhizol isomer (12.7%), methyl eugenol (10.5%), palmitic acid (5.2%) and camphor (4.2%), whereas the rhizomes oil from Southern India had germacrone (12.8%), camphor (12.3%), isoborneol (8.7%), curdione (8.4%) and 1,8-cineole (4.8%) as major constituents.[46]

C. aromatica Salisb

Rhizome greyish yellow within. Leaves distichous, lamina broadly lanceolate. Inflorescence lateral, peduncle covered by sheaths. Coma bracts pink and fertile bracts greenish-white. Corolla tube funnel-shaped, lobes unequal, pinkish-white, dorsal lobe broadly ovate and lateral lobes oblong. Labellum orbicular, deep yellow. Lateral staminodes oblong, style filiform [Figure 1o-q].

Rhizomes are used in combination with astringents and aromatics for bruises, sprains, hiccough, bronchitis, cough, leucoderma and skin eruptions.[6] Oil is used for treatment of early stage of cervix cancer. It was reported that the compounds such as Curdione, neocurdione, curcumol, tetramethylpyrazine and (R)-(+)-1,2-hexadecanediol were present in *C. aromatica*. Eocurdione and (R)-(+)-1,2-hexadecanediol were isolated from *C. aromatica* for the first time. Phytochemical investigation of the methanolic extract of the rhizomes yielded three new homosesterterpenoids characterized as 5, 9, 13, 17, 20-pentamethyl-n-heneicos-cis-3-en-6b, 7b, 8b-triol (curcusesterterpene A); 5, 9, 13, 17, 20-pentamethyl-n-heneicos-cis-6-en-2b, 4b, 5a-triol (curcusesterterpene B); 5, 9, 13, 17, 20-pentamethyl-n-heneic os-cis-3-en-6β, 7β, 9 α-triol (curcusesterterpene C) along with the known compounds n-nonacosan-1-ol and curcumin. The volatiles were examined by a combination of GC, GC-MS techniques. Out of the 45 constituents separated by GC, 32 were identified, the most notable being germacrene-D, curzerene, germacrone, curzerenone, xanthorrhizol, curcuphenol and hydroxyisogermafurenolide.[11]

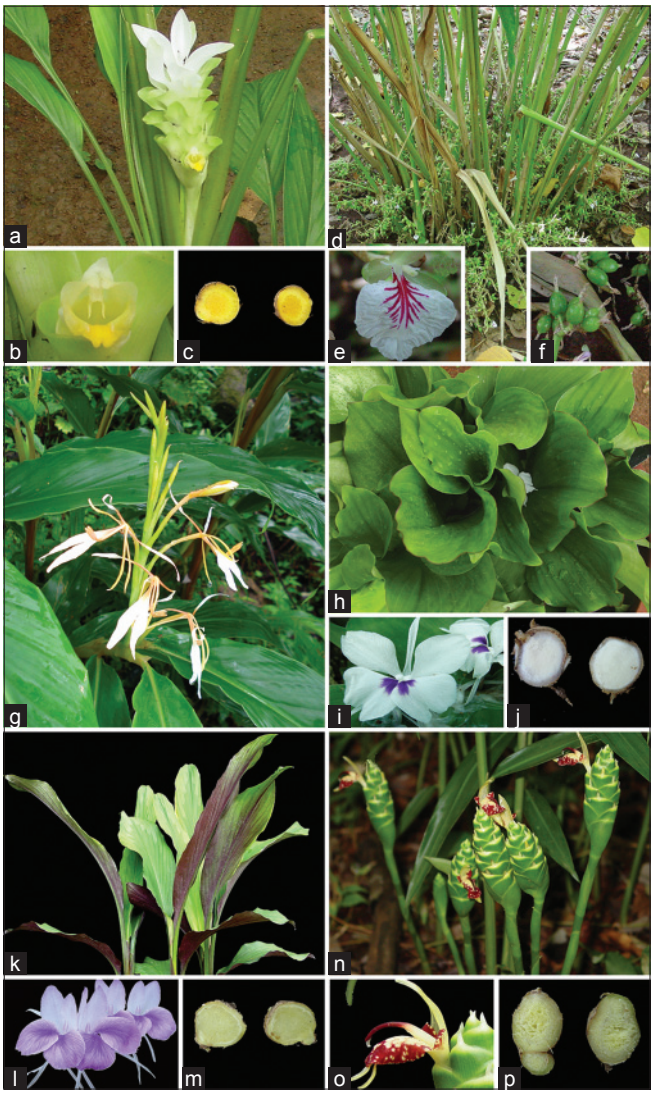

Figure 2: (Insight: Close-up of flower and c.s. of rhizome/fruits). (a-c) *C. longa* L.; (d-f) *Elettaria cardamomum* (L.) Maton; (g) *Hedychium spicatum* Buch.-Ham. ex J.E. Sm.; (h-j) *Kaempferia galanga* L.; (k-m) *Kaempferia rotunda* L.; (n-p) *Zingiber officinale* Roscoe

C. longa L.

Rhizome conical, orange-yellow inside, strongly aromatic. Lamina oblong-lanceolate. Ligule short, near the lamina. Inflorescence central, spike with coma and fertile bracts. Flowers equal to the bracts. Bracteoles ovate-oblong. Corolla lobes unequal, dorsal lobe larger and lateral lobes linear and small. Labellum trilobed, middle lobe emarginated. Anther thecae spurred. Style filiform, stigma bilipped. Fruiting not common [Figure 2a-c].

Turmeric has been used as a remedy for all kinds of poisonous conditions ulcers and wounds.[47] It gives good complexion to the skin and so it is applied to face as a depilatory and facial tonic. The drug cures diseases due to morbid *vaata*, *pitta* and *kapha*, diabetes, eye diseases, ulcers, edema, anemia, anorexia, leprosy and scrofula. It purifies blood by destroying the pathogenic organisms. The drug is also useful in cold, cough, bronchitis, conjunctivitis and liver affections.[48,49] The rhizome is an important ingredient of formulations such as *Nalpāmarādi tailam, Jātyādi tailam, Nārāyaṇa guḷa,* etc.[9]

Pulverized rhizome of *C. longa* on hydrodistilation, yielded 1.24% of essential oil. The oil was investigated by GC and GC/MS. Hydrocarbon monoterpenes (46.9%) constituted the bulk of the oil. The major constituents

of oil were ar-turmerone (31.7%), α-turmerone (12.9%), β-turmerone (12.0%) and (Z) β-ocimene (5.5%) $-bisabolene (13.9%), trans-ocimene (9.8%), myrcene (7.6%), 1,8-cineole (6.9%), "-thujene (6.7%) and thymol (6.4%). The major chemical constituent of the volatile oil from *C. longa* is alpha-curcumene.[50]

C. zedoaria (Christm.) *Roscoe*

Rhizome greyish to yellow inside, whitish toward the periphery. Lamina oblong-lanceolate. Inflorescence lateral, spike 10-15 cm with a distinct coma. Coma bracts deep pink, fertile bracts broadly ovate, green with pink tip. Bracteoles, outer larger, innermost white to light pink. Flowers as long as or slightly smaller than the bracts, Corolla tube funnel-shaped, lobes unequal. Labellum broad, light yellow with a median dark yellow band. Stamen spurred at base. Stigma slightly exserted from the anther.

The rhizome of *C. zedoaria* is used as appetizer and tonic, particularly prescribed to ladies after childbirth. In case of cold, a decoction of long pepper (*Piper longum*), cinnamon (*Cinnamomum verum*), zedoary and honey is given. In Ayurveda, it is an ingredient of "*Bratictyādi kwatha*", used in high fever.[7] The identity of the plant sources of the drug *C. zedoaria (Karcura)* is a matter of debate. There is difference of opinion among men of Ayurveda, as to whether *Sati* and *Karcura* are the same drug or different. Many authors consider them different and equate *Sati* with *Hedychium spicatum* Smith. and *Karcura* with *C. zedoaria*, both belonging to Zingiberaceae.[10] It was reported by Sharma[51] that, the essential oil of its dried rhizome yielded 36 compounds, including 17 terpenes, 13 alcohols and 6 ketones. Among the constituents, epicurzerenone and curzerene were found in the first and second highest amounts in this species.

Elettaria Maton

The generic epithet *Elettaria* is derived from Rheed's *Elettari. Elathari* (Modern transcription of Rheed's name) is still used for the seeds of *E. cardamomum* (*thari* means granules). The genus consists of about 8 species. Only one species, *E. cardamomum* occurs in India and this is the only economically important species. The genus is distributed *from Sri Lanka to Malaysia and Indonesia.*[3]

Elettaria cardamomum (L.) Maton

Rhizome branched, thick. Leaves bifarious, elliptic-lanceolate. Flowers in prostrate or erect, bracts scarius, calyx tubular, corolla white, tube equal to the calyx, lobes unequal, oblong; Labellum obovate, white with red lines; stamen, filaments short; anther cells parallel, shortly spurred, staminodes short, ovary 3-celled, ovules many, style filiform, stigma funnel shaped. Capsule ellipsoid, striate, seeds many, angular, fragrant [Figure 2d-f].

The dried capsules, the essential oil, oleoresin and tinctures are extensively used in the formulation of compounded mixtures for liquors beverages baked goods, canned foods, meats, sauces and condiments. Cardamoms are stimulant, carminative and flavoring agent. Dried cardamom fruits are used as a masticatory and in medicine. They are used for flavoring curries, cakes, bread and other culinary purposes. Seeds used to treat eye inflammation, kidney and urinary disorder, infection of teeth, throat trouble, congestion of lung and pulmonary tuberculosis, asthma, heart disease, digestive disorder, cold, snake bite, scorpion bite, masticatory.[52] The volatile oil constituents of this species were extracted and identified. The major constituents are α-terpinyl acetate, 42.3%; 1,8-cineole, 21.4%; linalyl acetate, 8.2%; limonene, 5.6%; and linalool, 5.4%.[53]

Hedychium Koenig

The name *Hedychium* comes from the Greek words, *Hedys* (sweet) and *chion* (snow), referring to the fragrant white flowers. The genus has about 80 species, mostly distributed in Indo-Malayan region.[3] Among this, only one species *Hedychium spicatum* is used as a raw drug for different ayurvedic preparations.

Hedychium spicatum Buch.-Ham. ex J.E. Sm.

Leafy shoots up to 1 m high. Leaves distichous, lamina oblong-lanceolate. Inflorescence terminal, spike lax or dense flowered. Bracts oblong or convolute round the calyx. Bracteoles smaller than the bracts. Flowers longer than the bracts. Calyx tubular, longer than or shorter than the bracts. Corolla tube long, slender, lobes equal. Labellum deeply lobed, lateral staminodes linear. Stamen shorter than the labellum, filament red or pale yellow. Anther straight or curved. Ovary trilocular. Fruit globose [Figure 2g].

The rhizome in powder form is sprinkled as an antiseptic agent and also used as a poultice for various aches and pains. It is a carminative and bronchodialator. The drug is an ingredient of some Ayurvedic preparations but rarely used in Unani system. Because of its camphotraceous odor, this drug is often considered as a substitute of *Curcuma zedoaria.*[7]

The root stock is useful in inflammations, asthma, pains, foul breath, bronchitis, hiccough, vomiting and diseases related to blood. It is also used as a laxative, stomachic, carminative, stimulant, tonic to the brain, in liver complaints, diarrhea and pains.[39] A furanoid diterpene, hedychenone and

7-Hydroxyhedychenone were found in the rhizomes of Hedychium spicatum.[54]

Kaempferia L.

The generic name commemorates Engelert Kaempfer, a German naturalist and Physician. The genus includes about 70 species, two-third of which is found in Asia and remaining one-third in Africa.[55] In Southern India, 3 species are reported, *K. galanga, K. rotunda* and one ornamental species, *K. elegans*.[56]

Kaempferia galanga L.

Rhizome strongly aromatic, lamina broadly ovate to orbicular. Inflorescence sessile, imbricating leaf sheaths, bracts bifarious, outer larger, inner smaller ovate-acuminate, bracteoles split to the base, transparent. Calyx equal to or shorter than the bracts. Corolla lobes white, linear. Labellum slightly broader than long, lateral staminodes, obovate, white. Anthers white, sessile. Stigma globular with a lateral slit. Epigynous glands erect, embracing the lower part of the style [Figure 2h-j].

Kaempferia galanga is a geophilous aromatic perennial herb with very fragrant rhizomes and ovoid to spherical white tubers at the tips of fibrous roots. Leafy stem is short or absent, flowers few to many, spirally arranged, produced singly in the axils of bracts.[9]

The leaves are used for pharyngodynia, ophthalmia, swellings, fever and rheumatism.[6] *Kaempferia Galanga*, also called regionally as *Karcura* (*Kacholam*) is a reputed remedy for all diseases caused by the morbidity of *vāta* and *kapha* and is especially useful in respiratory ailments such as cough, bronchitis and asthma. The drug is reported to be acrid, hot, bitter and aromatic. It cures skin diseases, wounds and splenic disorders. The rhizome is a constituent of a variety of Ayurvedic preparations like *Daśamūlāriṣṭam, Valiya rāsnādi kaṣāyam, Kaccorādi cūrṇa, Aśanā elādi tailam, Valiya Nārāyaṇa tailam, etc*.[40] The identity of the plant sources of the drug Karcura is a matter of debate. The source of Karcura in Kerala in the recent times has been *Kaempferia galanga*.[9] It was reported by Wong *et al*.,[57] that the composition of the essential oil of rhizomes of *K. galanga* L. contained 54 components, of which the major constituents were ethyl trans-p-methoxycinnamate (51.6%), ethyl cinnamate (16.5%), pentadecane (9.0%), 1,8-cineole (5.7%), γ-car-3-ene (3.3%) and borneol (2.7%). Terpenoid constituents amounted to 16.4%.

Kaempferia rotunda L.

Leafy shoot 50-65 cm high. Leaves few, erect, lamina oblong-lanceolate, purple beneath, mottled green above, ligule small, hairy. Inflorescence appearing before the leaves, enclosed within greenish-purple. Calyx unilaterally split, tip with two dorsal ridges, light violetish, transparent. Corolla tube slightly longer than the calyx, lobes white, very narrow, lanceolate with acuminate tip. Labellum broadly ovate, lateral staminodes ovate elliptic. Filament short, erect, sparsely pubescent. Stigma slightly flattened and cupular, margin hairy. Fruiting not common [Figure 2k-m].

In Ayurveda, the important formulations using this herb are *Cyavanaprāśam, Aśokāriṣṭam, Baladhātryādi tailam, Kalyanakaghritham*, etc.[9] The drug "*Hallakam*" prepared from this is in popular use in the form of powder or as an ointment application to wounds and bruises to reduce swellings. The tubers are useful in vitiated conditions of *vāta* and *kapha*, gastropathy, dropsy, inflammations, wound, ulcers, blood clots, tumours and cancerous swellings.[6] The volatile constituents of rhizomes (main rhizome, lateral parts), *Kaempferia rotunda* were investigated by GC and GC-MS analysis. A total of 75 compounds were identified. The most abundant constituents were benzyl benzoate (69.7%, 20.2%), n-pentadecane (22.9%, 53.8%) and camphene (1.0%, 6.2%).[57]

Zingiber Boehm.

The generic epithet *Zingiber* was derived from Tamil "ingiver" meaning ginger rhizome. This term is spread to ancient Greece and Rome through the Arab traders and from them to Western Europe. Some authors believed that the name was derived from the Sanskrit word "*Sṛngavera*", which means "horn-root," rhizome.[3] The genus is represented by 141 species,[58] distributed mainly in tropical Asia. In India the genus is represented by 12 species and among this *Z. officinale* has a greater role in the preparations of various ayurvedic drugs.

Zingiber officinale Rosc.

Rhizome palmately lobed, greyish-yellow within, pungent. Lamina narrowly lanceolate. Inflorescence radical, leafless peduncle. Bracts green with a paler membranous margin, bracteoles ovate-oblong. Flowers longer than the bracts, fragile. Corolla tube included within the bracts, lobes almost equal. Labellum more or less round, dark purple, blotched creamy-yellow. Stigma white, prolonged above the crest. Ovary glabrous [Figure 2n-p].

The fresh rhizome is used to prepare *Ārdrakaghrta, Sranadighrta, Valiya cincādi leha, Mahakukkuṭamāṃsataila, etc*., The dried ginger forms an ingredient of preparations like *Indukāntam kaṣāyam, Suraṇādi leha, Talisapatravataka, Visvamrta, etc*.[9] Ginger juice produces antimotion

sickness action by central and peripheral anticholinergic antihistaminic effects.[54] The essential oil and oleoresins (ethanol, methanol, CCl_4 and isooctane) of *Z. officinale*. Geranial (25.9%) was the major component in essential oil; eugenol (49.8%) in ethanol oleoresin, whereas in the other three oleoresins, zingerone was the major component (33.6%, 33.3% and 30.5% for, methanol, CCl_4 and isooctane oleoresins, respectively).[59]

CONCLUSION

In the present study, 13 Zingiberaceous herbs used as raw drug for various ayurvedic formulations have been documented. In the genus *Alpinia*, *A. galanga* is the most important one, which finds varying uses in ayurvedic preparations such as "*Rāsnādi powder*". In *Curcuma*, *C. longa* is the most popular one, which has been studied in greater depths already. *C. aromatica* is used in the treatment of skin diseases and is extensively used in vanishing creams. *Kaempferia galanga* has become very popular and is identified to have tremendous effect in curing bronchial and gastric diseases. Of late, it is being used in preparations of mouth washes and oral deodorants. *K. rotunda* is another related crop under this genus, which has potential for great exploitation on a commercial basis. *Zingiber officinale* has also plays a major role in the preparation of various Ayurvedic formulations.

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