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Phytochemical and Pharmacological Aspects of *Murraya koenigii*

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An attempt has been made to provide upto date references that are categorized on the basis of phytochemical and pharmacological basis.

Key Words: ***Murraya koenigii*, Rutaceae, Curry, Meetha neem.**

INTRODUCTION

Murraya is a cosmopolitan genus of two species belonging to family Rutaceae, *viz., Murraya koenigii* found in India and *Murraya paniculata* found in China. The leaves and roots are bitter, acrid, cooling, analgesic, cure piles, antipyretic, thirsting, cause inflammation, itching, useful in leukoderma and blood disorders.

The roots and leaves are used as stimulants. Externally, they are used to cure eruptions and the bites of poisonous animals. The entire plant and specially leaves are used in Ayurveda[1].

Leaves are commonly known in Hindi: Meetha neem, Marathi: Kadhipatta, English: Curry leaves, German: Curry blatter, Gujarati: Mitho limdo, Oriya: Basango, Punjabi: Bowala, Tamil: Karuvepila[2].

Geographical distribution

The curry tree is *Chalcas koenigii* or *Murraya koenigii,* of the Rutaceae family and is native to India, especially the South, often growing wild. In South and Central India, curry tree leaves have been extremely prevalent as a flavouring agent.

"Curry" refers simply to certain leaves, most often from two plants. One is a shrub, *Helichrysum italicum* or *H. angustifolium,* a member of the Asteraceae family and a relative of immortelle. Several subspecies grow in Mediterranean countries.

In English usage, "Curry" refers to Eastern-style spice mixtures—powders or pastes—or the dishes they flavour, most typically vegetable or meat dishes served

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with rice and chutney. Curry mixtures originate in India, Sri Lanka, Myanmar, Thailand, Vietnam, Malaysia and Indonesia. They differ in their ingredients and tastes[3].

Morphology of leaf

Leaves are imparipinnate up to 10 cm long; petioles pubescent; leaflets 11–25, alternate, 2–5 by 1–2.5 cm, obliquely ovate or somewhat rhomboid, acuminate, obtuse or acute, tip usually notched (the lower leaflets often suborbicular or obovate, much smaller than the upper), irregularly crenate-dentate, glabrous or nearly so above, pubescent beneath. Sprinkled with black dots; petiolate very short[2] (Fig. 1).

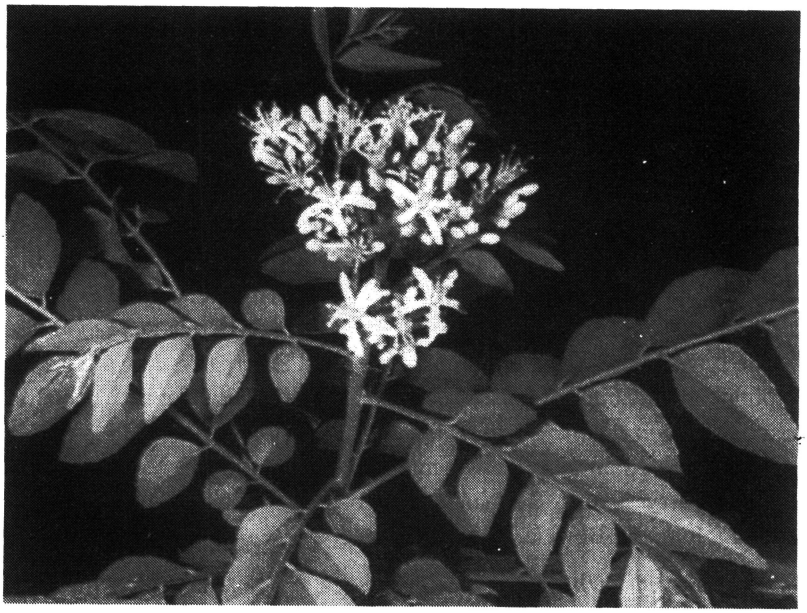
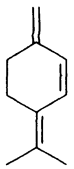


Fig. 1. Plant of *Murraya koenigii*

Phytochemical investigations on *Murraya koenigii*

Total seed lipid from *Murraya koenigii* was extracted by Hemavathy[4]. It amounted to 4.4% of dry seeds. The total lipids consisted of 85.4% neutral lipids, 5.1% glycolipids and 9.5% phospholipids. Essential oil was obtained by Wong *et al.*[5] from steam distillation of the leaves of *Murraya koenigii*. India curry leaf tree was analyzed by capillary GC and GC-MS. Sixty-two components constituting 96.95% of the oil were identified, with β-phellandrene (Structure-1) (24.4%), α-pinene (Structure-2), terpene-4-O-ol (Structure-3) (6.1% and 17.5%), β-caryophyllene (Structure-4) (7.3%) as the major constituents.

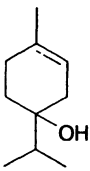


Beta-phellandrene

Structure-1

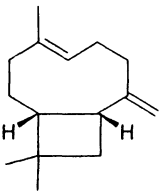
Alpha-pinene

Structure-2



Alpha-terpeneol

Structure-3



Beta-Caryophyllene

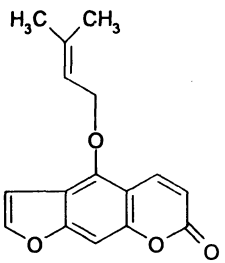
Structure-4

Minor alkaloid mahanine was isolated by Atta-ur-Rahman *et al.*[6] from the leaves of *Murraya koenigii*. A new carbazole alkaloid, 2-methoxy-3-methylcarbazole, was isolated by Bhattacharaya *et al.*[7] from the petroleum ether extract of the seeds of *Murraya koenigii*. Glycozoline for the first time was isolated from *Murraya koenigii* by Adesina *et al.*[8]

Alkaloidal constituents of root and stem bark of *Murraya koenigii* were studied by Ito *et al.*[9] Three new monomeric and five novel binary carbazole alkaloids named mukoenine-A, -B and -C and murrastafoline-f, bis-2-hydroxy, bis-2-hydroxy-3-methyl carbazole, bis-mahanine, bikoenquinone-a and bis murraya-quinone-A, respectively, were isolated, as well as 16 kinds of known carbazols and carbazolequinones and their structures were elucidated by spectrometric methods. Among the new binary carbazoles, bikoenquinone-A and bis murraya-quinone-A were found to contain a carbazole-1,4-quinone skeleton as a basic structural unit.

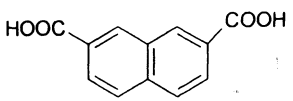
The chemical structure of isolated alkaloids of *Murraya koenigii* have been shown by Bhattacharaya *et al.*[10] to be 2-methoxycarbazole-3-methyl carboxylate 1-hydroxy-3-methyl carbazole using spectroscopic and chemical evidence.

Resich *et al.*[11] isolated isoheraclenin (0.00064%), isoimperatorin (Structure-5) (0.00208%), oxypeucedanin (0.000208%), isopimpinellin (0.00074%) and bergapten (Structure-6) (0.0018%) from *Murraya koenigii*.



Isoimperatorin

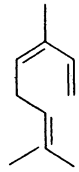
Structure-5



Bergapten

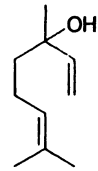
Structure-6

Volatile oil constituent of *Murraya koenigii* flowers was analyzed[12] by capillary GC and GC-MC following isolation by solvent extraction. Forty-eight compounds were identified, mono-terpenoids and sesquiterpenoids accounting for 34.4 and 43.9% of the total volatiles, respectively. The major compounds were β-carophyllene (24.2%), (E), β-ocimene (Structure-7) (18.0%) and linalool (Structure-8) (8.0%).



Beta-ocimene

Structure-7



Linalool

Structure-8

Cytotoxicity activity was reported by Chakrabarty *et al.*[13] Two new alkaloids, 9-carbethoxy-3-methylcarbazole and 9-formyl-3-methylcarbazole, and a known metabolite, 3-methyl-carbazole isolated from the roots of *Murraya koenigii.* Their structures were confirmed by synthesis of the two new metabolites, the 9-formyl compound displayed weak cytotoxicity against both mouse melanoma B16 and adriamycin-resistant P388 mouse leukemia cell lines.

Adebajo *et al.*[14] isolated 2″,3″-epoxyindicolactone from *Murraya koenigii.* Indicolactone, anisolactone and a new furocoumarin lactone, 2″,3″-epoxyindicolactone were isolated from the seeds of *Murraya koenigii.* Their structures were established by spectroscopic methods. This represents the first report of furocoumarins with a monoterpenoid lactone chain in the genus Murraya.

Two new carbazole alkaloids as koenigine-quinone A and koenigine-quinone B were designated by Saha *et al.*[15] They were isolated from the alcoholic extract of the stem bark of *Murraya koenigii* and their structures were established as 7-methoxy-3-methylcarbazole-1,4-quinone and 6,7-dimethoxy-3-methylcarbazole-1,4-quinone, respectively. Hydro-distillation of the leaves of *Murraya koenigii* gave essential oil (0.5%) on fresh weight basis to Chowdhury[16]. On examination by GC-MS the oil was found to contain aromadendrene, β-bisabolene, butyl myristrate, carvo-methone, *cis*-carrophylene, β-costol, cirtalcamphene, *trans*-caryophyllene, *iso*-caryophyllene, camphene, dipentene, dehydromadendrene, β-eudesmol, farnesol, junipene, stearic acid, linalyl acetate, isomenthone, menthol, spthulenol, stearyl alcohol, ateraldehyde, β-elemene, α-pinene, plamitic acid, α-terpineol and zingiberene. The composition of the oil suggests that the oil may find application as a fixative in heavy type soap and detergent perfumes.

Ascorbic acid was reported by Ramalakshami *et al.*[17] Blanching had a significant effect on texture, chlorophyll and ascorbic acid content of curry leaf.

Wang *et al.*[18] isolated two new carbazole alkaloids namely murrayanine and 8,8″-biskoenigine from *Murraya koenigii.* The compound murrayanine was a novel carbazole alkaloid with a rare phenylpropanyl substitution. The compound 8,8″-bis-keonigine was a symmetrical dimer of the carbazole alkaloid koenigine and showed antiosteoporotic activity in the CAT-B model with IC(50) 1.3 μg/mL.

Kureel *et al.*[19] determined the structure and synthesis of terpenoid alkaloid mahanimbine from *Murraya koenigii* Spreng.

Pharmacological screening

Ramsewak *et al.*[20] bioassayed fractionation of the acetone extract of the fresh leaves of *Murraya koenigii* resulting in the isolation of three bioactive carbazole alkaloids, mahanimbine, murrayanol and mahanine, as confirmed from their ^{1}H and ^{13}C NMR spectral data. Murrayanol showed an IC^{50} of 109 μg/mL against hPGHS-1 and an IC^{50} of 218 μg/mL against hPGHS-2 in antiinflammatory assays, while mahanimbine displayed antioxidant activity at 33.1 μg/mL. All three compounds were mosquitocidal and antimicrobial and exhibited topoisomerase I and II inhibition activities.

Antibacterial, antiinflammatory, antifeedant activity of root extract have also been evaluated by Srivastava *et al.*[21] It was due to murrayeno, murrayagetin and marmesin-1″-O-rutinoside along with substances epilupeol and umbelliferone.

Sharma *et al.*[22] revealed that the extract obtained in alcohol proved superior over the extract in other solvents in reducing egg hatching and oviposition.

Crude ethanol extract of the leaves and the chloroform-soluble fraction reported promising antibacterial activity against almost all of the tested bacteria by Nutan *et al.*[23] The maximum activity was exhibited by the chloroformsoluble fraction against *Bacillus cereus*. Petroleum ether fraction, carbon tetrachloride fraction, murrayanol and isomahanine were not so active. However, petroleum-ether soluble fraction proved to be most cytotoxic.

Thomas *et al.*[24] reported the methanollic extracts of *Murraya koenigii* plant having antibacterial activity against multi-resistant bacteria including gram +ve and gram –ve strains.

Srivastava *et al.*[25] found that the essential oils of *Murraya koenigii* corrected non-motility, more than 50% at 125 ppm level after 24 h exposure to root knot nematode (*Meloidogyne incognita*). Benzene extract was found to be more antinemic (43.6 h) than hexane extract (49.8 h). Antinemic activity of pure carbazole alkaloids, *e.g.*, koenimbine, koenidin (LT^{50} 58.7 and 56.3 h) was improved by their derivatization into corresponding N-methyl koenimbine and N-methyl koenidine (LT^{50} 42.7 and 39.4 h). The chief chemical constituents of essential oils were identified as β-caryophyllene (29%) and β-gurjunene (21%).

Two new alkaloids reported by Chowdhury *et al.*[26] are 1-formyl-3-methoxy-6-methylcarbazole and 6,7-dimethoxy-1-hydroxy-3-methylcarbazole. They are active against gram positive and gram-negative bacteria and fungi.

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