A REVIEW ON MURRAYA KOENIGII (CURRY PLANT) - MEETHI NEEM

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ABSTRACT

“Medicine is food and food is medicine” is the best way to describe how the ailments were cured by using the plants during the ancient period of time. The “Magical plant of Indian Spice” (Murraya koenigii) has served humankind not only as food enhancer but also serve as village or folk medication to cure many disorders, the tribal communities has used many parts of the Murraya koenigii to cure them. Murraya koenigii used to cure dysentery disorders, renal pain, stomach upsets and morning sickness. Carbazole alkaloids which are abundantly present in the leaves, fruits, roots and bark of this plant, have been reported for their antidiabetic, anticancer, antibacterial, antinociceptive and antioxidant activities. Besides these activities, the plant is described to have a wide array of therapeutic activities.

Phytochemistry and pharmacology of this plant necessitates a comprehensive review of its prospects as an important therapeutic agent for the management of numerous diseases commonly affecting humans.

KEYWORDS: Murraya koenigii, Pharmacological activity, phytochemistry, traditional use.

INTRODUCTION

Murraya koenigii, commonly known as curry leaf or Kari patta in Indian dialects, belonging to Family Rutaceae which represent more than 150 genera and 1600 species.[1] Murraya Koenigii is a highly values plant for its characteristic aroma and medicinal value. It is an important export commodity from India as it fetches good foreign revenue. A number of chemical constituents from every part of the plant have been extracted. The most important chemical constituents responsible for its intense characteristic aroma are P-gurjunene, P-
caryophyllene, P-elemene and O-phellandrene. The plant is rich source of carbazole alkaloids.[2] Bioactive coumarins, acridine alkaloids and carbazole alkaloids from family Rutaceae were reviewed by Ito.[3] Murraya koenigii Linn (Rutaceae) commonly known as Meethi neem, is an aromatic more or less deciduous shrub or a small tree up to 6 m in height found throughout India up to an altitude of 1500 m and are cultivated for its aromatic leaves.[4] In traditional system of Medicine, it is used as antiemetic, anti diarrhoeal, dysentery, febrifuge, blood purifier, tonic, stomachic, flavoring agent in curries and chutneys. The oil is used externally for bruises, eruption, in soap and perfume industry.[5] It is reported to possess antioxidant, antibacterial, antifungal, larvicidal, anticarcinogenic, hypoglycemic, anti-lipid peroxidative, hypolipidemic and antihypertensive activity.[6] Murraya koenigii L belong to family Rutaceae, a perennial shrub or small tree commonly cultivated in India, Sri Lanka and other Asian countries.[7] It is locally known as curry leaf plant due to presence of aromatic smell, ornament and used as a natural flavoring agent for various food preparations.[8] Leaves have somewhat pungent, bitter and weakly acidulous taste and these characteristics retained after drying. The leaves are highly valued as seasoning along with sliced onions in Indian and Asian countries cooking. Fresh leaves dried powder and volatile oils are comprehensively used in India to provide flavor in many food dishes preparation and materials.[9, 10] Oil used in soap and cosmetic industries.[11]

DISTRIBUTION
According to the author, Murraya koenigii is distributed and cultivated throughout India. It is found from Sikkim to Garhwal, Bengal, Assam, Western Ghats and Travancore-Cochin. The seeds germinate without restraint under shade or partial shade. This curry leaves can be found in moist forest of 500-1600 meters” in height especially in Guangdong, S Hainan, S Yunnan, Bhutan, Laos, Sri Lanka, Thailand, Nepal, Vietnam. Upon with the South India immigrants the curry leaves arrives to Malaysia, South Africa, and Reunion Island.[12]

PHARMACOLOGICAL ACTIVITY
Curry leaves are rich in many minerals and trace minerals such as Iron, zinc and copper. Therefore, researchers recommended in a study published in January 2007 in "Chemico-Biological Interactions" that people with diabetes may benefit from the addition of curry leaves in the diet. Minerals found in curry leaf extract are important for maintaining normoglycemia, or the normal glucose content of the blood. This is done by the activation of pancreatic beta cells, which are responsible for the creation of insulin. While the nutrients in
curry account for only about 1 to 2 percent of the required daily intake for these elements, they are bioavailable, or readily usable by the body. Therefore, the researchers suggested that curry leaves may be useful for the management of diabetes. A scrutiny of literature reveals some notable pharmacological activities of the plant such as activity on heart, Anti diabetic and cholesterol reducing property, antimicrobial activity, antiulcer activity, antioxidative property, cytotoxic activity, anti-diarrhea activity, phagocytic activity.\textsuperscript{[13]} The antioxidative properties of the leaves extracts of Murraya koenigii using different solvents were evaluated based on the oil stability index.\textsuperscript{[14]} M. koenigii possesses statistically significant hypoglycemic potential in STZ-induced diabetic rats. The M. koenigii extract appeared to be more effective than glibenclamide, a known antidiabetic drug.\textsuperscript{[15]} It also revealed hepatoprotective activity against ethanol-induced hepatotoxicity. Chronic ethanol consumption diminishes the cellular antioxidant levels through free radical induced injury causing hepatitis and cirrhosis with mortality in severe cases.\textsuperscript{[16]} It also shows antibacterial activity against S. typhi and E.coli.\textsuperscript{[17]} Carbazole derivatives are well known for their various pharmacological activities, including anti-HIV, anticancer, antibacterial and antifungal activities. A series of substituted carbazoles, termed N-alkylated 3,6-dihalogenocarbazoles, that exhibit fungicidal activity against C. albicans and the emerging pathogen Candida glabrata. The most potent fungicidal compounds of this series were characterized et al., by minimal fungicidal concentration (MFC) between 8.5 and 25 µM.\textsuperscript{[18]}

**TRADITIONAL USES**

Fresh leaves, dried leaf powder, and essential oil are widely used for flavouring soups, curries, fish and meat dishes, eggs dishes, traditional curry powder blends, seasoning and ready to use other food preparations. The essential oil is also utilized by soap and cosmetic aromatherapy Industry.\textsuperscript{[19]} Curry leaves are boiled with coconut oil till they are reduced to blanked residue which is then used as an excellent hair tonic for retaining natural hair tone and stimulating hair growth. It is traditionally used as a whole or in parts as antiemetics, anti diarrheal, febrifuge, blood purifier, antifungal, depressant, anti-inflammatory, body aches, for kidney pain and vomiting.\textsuperscript{[20]}

**PHARMACOLOGICAL STUDIES**

**ANTIBACTERIAL ACTIVITY**

The essential oil from *Murraya koenigii* leaves showed antibacterial effect against B. subtilis, S.aureus, C. pyogenes, P. vulgaris and Pasteurella multocida. The pure oil was active against
the first three organisms even at a dilution of 1: 500.\textsuperscript{[21]} The acetone extract of the fresh leaves of \textit{Murraya koenigii} on fractionation gives three bioactive carbazole alkaloids named as mahanimbine, murrayanol and mahanine, which has shown mosquitocidal, antimicrobial and topoiso
ermase I and II inhibition activities.\textsuperscript{[22]}

\textbf{ANTIFUNGAL ACTIVITY}

The essential oil from leaves of \textit{Murraya koenigii} showed antifungal activity against \textit{C. albicans}, \textit{C. tropicalis}, \textit{A. niger}, \textit{A. fumigates}, \textit{Microsporum gypseum} and \textit{Murraya koenigii} was effective against \textit{C. albicans} even at a dilution of 1:500. The ethanolic extract of the leaves showed fungi toxicity against \textit{Colletotrichum falcatum} and \textit{Rhizoctonia solani}.\textsuperscript{[23]} The ethanolic extract of the roots and also the whole plant excluding roots of \textit{Murraya koenigii}, however, did not show any antifungal activity against \textit{Cryptococcus neoformans}, \textit{Trichophyton mentagrophytes} and Microsporum canis.\textsuperscript{[24, 25]}

\textbf{ANTIPROTOZOAL ACTIVITY}

Ethanolic extracts (55 \%) of \textit{Murraya koenigii} whole plant excluding roots (extract A) and roots alone (extract B) were screened for their pharmacological actions. Extract A showed antiprotozoal action against \textit{Ent. Histolytica}, antispasmodic effect on isolated guinea pig ileum, whereas extract B showed antiprotozoal activity against \textit{Ent. Histolytica} and as well as antihypertensive activity in cat/dog.\textsuperscript{[26]} (See table 1.)

\textbf{ANTIPYRETIC ACTIVITY}

The rats were fevered with the parentral administration of 10mg/kg of brewer’s yeast and were found that the ethanol extract of \textit{Murraya koenigii} leaves poses an antipyretic activity compared to petroleum ether extract and chloroform extract, with paracetamol dose of 150mg/kg as a standard drug.\textsuperscript{[27]}

\textbf{HYPOGLYCEMIC EFFECTS}

The plasma glucose levels were found to be decrease in the alloxon induced rats on treatment with aqueous and methanolic extract of \textit{Murraya koenigii} leaves.\textsuperscript{[28]} The ethanolic extract of \textit{Murraya koenigii} stem shows remarkable reduction in the blood glucose level, total cholesterol level, triglyceride and body weight.\textsuperscript{[29]} Mahanimbine which is a carbazole alkaloid obtained from \textit{Murraya koenigii} leaves shows antihyperglycemic and hypolipidemic activity, in which intra-peritoneal administration of 50mg/kg and 100mg/kg for once a week for 30 days has shown anti hyperglycaemic effects and hypolipidemic effects on
streptozotocin induced adult male wistar rats with non hypoglycaemic shock in diabetic rats. In the 30 days of the treatment it was found a significant reduction in the total cholesterol level, triglycerides, low density lipoprotein and very low density lipoprotein and increased in high density lipoprotein levels. Furthermore, mahanimbine shows a marked alpha amylase inhibitory effects and weak alpha glucosidase inhibitory effects compared with the synthetic drug, acarbose.\textsuperscript{30}

**HEPATOPROTECTIVE ACTIVITY**
The methanolic extract of *Murraya koenigii* leaves at the doses of 200mg/kg, 300mg/kg and 500mg/kg has shown decrease in the elevation on hepatic marker enzymes (Aspartate transaminase, Alanine transaminase, Serum bilirubin and alkaline phosphate) as a result of administration of carbon tetrachloride on adult sprague-dawley rats. The maximal dose of 500mg/kg was comparable to the standard drug, Silymarin, which has been used clinically for the treatment of the liver disease.\textsuperscript{31} Aqueous extract of *Murraya koenigii* at the dose of 1g/kg and 2g/kg were used to evaluate the hepatoprotective activity on ethanol induced adult wistar rats. 1g/kg of the extract were found promising hepatoprotective activity against ethanol induced hepatitis. The aqueous extract inhibits the lipid per oxidation activity and enhances the cellular stability by inhibiting cellular necrosis. Furthermore, both of the extract doses were found to exhibit a comparable decrease in serum glutamate pyruvate transaminase (SGPT) and alkaline phosphatase (ALKP) less than L-ornithine- L- aspartate (LOLA) which serves as positive control. Besides that, the serum bilirubin has no major reduction in its level upon administration of both doses of the extract.\textsuperscript{32}

**ANTI-INFLAMMATORY**
The leaves of *Murraya koenigii* was subjected to extraction with free various solvents; petroleum ether, chloroform and ethanol. A dose of 250mg/kg was selected which is a 1/10th of 2500mg/kg which was considered as LD50, the dose was administrated via oral route. Compared to the three solvents, it was found that ethanolic extract shows significant reduction in carrageenan induced paw edema in the Albino rats of the wistar strain.\textsuperscript{33} Furthermore, it was found that the methanol and aqueous the extract of *Murraya koenigii* leaves is effective against carrageenan- induced edema in male albino rats at the dose of 400mg/kg, compared to petroleum ether and hexane extracts which has no decrease in the inflammation. The methanol extract was found to have an utmost anti-inflammatory activity compared to aqueous extract.\textsuperscript{34}
CYTOTOXIC ACTIVITY
Girinimbine, a carbazole alkaloid which is extracted from the root of *Murraya koenigii* exhibit cell death via apoptosis in a dose dependent manner in A549 cells. Furthermore, the author suggests that the cell death induced by the girinimbine can be via classical mitochondrial pathway with cytochrome C release and caspase dependent apoptosis.\(^{[35]}\) In addition to that, Koenoline from the root bark were found to have an anticancer activity against KB cell culture and the carbazole alkaloids from the stems has effects in the growth on human leukemia cell line HL-60.\(^{[36]}\)

ANTI-OBESE ACTIVITY
In a research done by the author, it was found that the ethanolic extract of *Murraya koenigii* leaves which were administrated orally to male wistar rats for 30 days, were effective in the reduction of body weight, cholesterol, triglyceride and as well as controlling the glycemic levels.\(^{[37]}\)

CHEMOPROTECTIVE ACTIVITY
A single dose of 100mg/kg of methanolic extract of *Murraya koenigii* leaves which is administered before cyclophosphomide at the dose of 50mg/kg via intraperitoneal administration on swiss albino mice has shown a significant reduction in the cyclophosphomide induced chromosomal damage and enhance the bone marrow protection.\(^{[38]}\)

ANTIHELMINTIC EFFECTS
The leaves of *Murraya koenigii* poses as antihelmintic effects, by which the ethanolic and aqueous extract of the leaves shows an antihelmintic effects against *Pheretima posthuma* and the both extract was comparable to the standard drug Piperazine. It is believed that tannins which are the polyphenolic compound found in *Murraya koenigii* leaves shows antihelminth effects. Futhermore tannins can act similar like the synthetic phenolic antihelmints such as the bithionol, oxyclozanide and niclosamide by interrupting the energy generation by uncoupling oxidative phosphorylation or by binding of the tannins to the free protein in the gastrointestinal tract of the host or binding to the glycoprotein on the cuticle of the parasite and causes the lethal effects on it.\(^{[39]}\) The methanolic extract of *Murraya koenigii* shows anthelminthic effects against the Indian earthworm (*Pheretima posthuma*) in a dose dependent manner. The methanolic extract causes the paralysis of Indian earth worm at 18 minutes and promotes lethal effect at 45 minutes.\(^{[40]}\)
INOTROPIC ACTIVITY

The ethanolic extract of the fresh leaves of *Murraya koenigii* shows a positive inotropic effect on the isolated frog heart in a dose dependent manner. It was suggested that the positive inotropic activity is achieved by an increase in the availability of calcium from the extracellular sites by the *Murraya koenigii*.\(^{[41]}\)

NEPHROPROTECTIVE

Oral administration of aqueous extract of *Murraya koenigii* leaves in a daily manner for 30 days instreptozotocin induced diabetic in male rats were found significant reduction in serum urea and creatinine levels and promote tissue regeneration in kidney.\(^{[42]}\)

**TABLE 1. Active compounds of *Murraya koenigii* and their activities**

<table>
<thead>
<tr>
<th><em>Murraya koenigii</em> compounds</th>
<th>Source</th>
<th>Biological activity</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lutein</td>
<td>Leaves</td>
<td>Antioxidant activity</td>
</tr>
<tr>
<td>Tocopherol</td>
<td>Leaves</td>
<td>Antioxidant activity</td>
</tr>
<tr>
<td>Carotene</td>
<td>Leaves</td>
<td>Antioxidant activity, Hepatoprotective</td>
</tr>
<tr>
<td>Koenimbine</td>
<td>Leaves</td>
<td>Antioxidant activity</td>
</tr>
<tr>
<td>Isomahanine</td>
<td>Leaves</td>
<td>Anticaries</td>
</tr>
<tr>
<td>Mahanine</td>
<td>Stem and bark</td>
<td>Antimicrobial</td>
</tr>
<tr>
<td>Murrayanol</td>
<td>Leaves</td>
<td>Mosquitocidal Anti-microbial</td>
</tr>
<tr>
<td>Murrayanine</td>
<td>Stem and bark</td>
<td>Antifungal</td>
</tr>
<tr>
<td>Girinimbine</td>
<td>Stem and bark</td>
<td>Anti-cancer Antifungal and antibacterial</td>
</tr>
<tr>
<td>Girinimbine</td>
<td>Leaves</td>
<td>Hepatoprotective</td>
</tr>
</tbody>
</table>

**SPECIFIC DATA ABOUT CURRY PLANT**

Specific gravity (25HC) = 0.9748
Refractive index (25HC) = 1.5021
Optical rotation (25HC) = + 4.8 [6]
Saponification value = 5.2
Saponification value After acetylation = 54.6
Moisture = 66.3%
Protein = 6.1%
Fat (ether extract) = 1.0%
Carbohydrate = 18.7%
Fibre = 6.4%
Mineral matter = 4.2%
Calcium = 810 mg/100 g of edible portion
Phosphorus = 600 mg/100 g of edible portion
Iron = 3.1 mg/100 g of edible portion
Caroten (as vitamin A) = 12 600 IU/100 g
Nicotinic acid = 2.3 mg/100 g
Vitamin C = 4 mg/100 g
Thiamine and riboflavin = absent.\(^{[43]}\)

**CONCLUSION**

Keeping in view the tremendous pharmacological activities and availability of literature, *Murraya koenigii* may be utilized to alleviate the symptoms of variety of diseases as evident from the pre-clinical data. Although crude extract from various parts of *Murraya koenigii* have numerous medical applications, modern drugs can be developed after extensive investigation of its bioactivity, mechanism of action, pharmacotherapeutics, toxicity and after proper standardization and clinical trials. The available literature and wide spread availability of *Murraya koenigii* in India thus makes it an attractive candidate for further pre-clinical and clinical research.

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**REFERENCES**


