MACRO AND MICROSCOPIC STUDY OF MEETHA NEEM
(MURRAYA KOENIGII LINN)

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ABSTRACT

Background: Meetha Neem (Murraya koenigii Linn.) commonly known as curry patta is a culinary important plant of Indian origin, and also been a component of many formulations used in the Ayurvedic system of medicine since many centuries. Objective: The current review provides a detailed report of the microscopic, macroscopic, phytochemical, works carried out on this culinary plant and also throws light on its therapeutic prospects. Methods: The plant was morphologically examined for shape of leaves, apex, base, margin etc. The powdered drug was separately treated with phloroglucinol – HCl solution, saffron reagent, glycerin and iodine solution to determine the presence of lignified cells, calcium oxalate crystals and starch grains; as a part of quantitative microscopy. Stomata number, stomatal index, vein islet and veinlet termination number were determined by using fresh leaves of the plant. Total ash, water and alcohol soluble ash, water soluble extractive values were determined. Results: All these parameters, which are being reported, could be useful in identification of distinctive features of the drug. Conclusion: From the phytochemical study, it can be concluded that only selected species of Murraya contains the reported phytoconstituents. Hence, detailed
screening may be done to isolate the active constituent so that it may be scientifically proved to access the pharmacological responses of the plant to ascertain its folklore uses.

**KEYWORDS:** Ayurveda, *Murraya koenigii* Linn., culinary plant, microscopic study.

**INTRODUCTION**

World’s about 80% population relies upon herbal products, because they have been considered as safe, effective and economical. The *Murraya koenigii* plant is widely used as herb, spice, condiments and also used to treat various types of ailments in Indian traditional system. *Murraya koenigii (Linn) Spreng.* or sweet neem also referred as Curry Plant is a popular tree which produces an aromatic leaf often used in Indian cuisine. The small and narrow leaves somewhat resemble the leaves of the Neem tree. Its tender, fern-like leaves have a spicy aroma and tangy flavor. It mainly grows in tropical and sub tropical climates. Curry leaf tree is native to India but also grows in Sri Lanka, Burma, Malaysia and South Africa.

**Scientific Classification**

Kingdom Plantae – Plants
Subkingdom Tracheobionta – Vascular plants
Superdivision Spermatophyta – Seed plants
Division Magnoliophyta – Flowering plants
Class Magnoliopsida – Dicotyledons
Subclass Rosidae
Order Sapindales
Family Rutaceae – Rue family
Genus Murraya J. Koenig ex L. – murraya
Species Murrayakoenigii (L.) Spreng. – curryleaf tree

**Various names**

English- Curry leaves; Kannada- Karibevu; Hindi- Karipatta, Mitha nim; Tamil- Kariveppilai; Malayalam- Kariveppu; Marathi- Kadhilimb; Sanskrit- Girinimba; Telugu- Karepeku; Tulu- Bevusoppu; Portuguese- Folhas de caril; Russian- Listya karri; Spanish- Hojas de curry; Italian- Fogli di Cari; French- Feuilles de Cari; German- Curryblatter; Gujarathi- Mitho limado.
Plant Description[4]
A small aromatic tree with dark grey bark. Leaves imparipinnate, alternate leaflets alternate, obliquely ovate, gland dotted and aromatic; flowers white in terminal corymbose cymes, fragrant; fruits subglobose berries dark purple when ripe. 2 seeded. Flowering starts from the middle of April and ends in the middle of May. The fruiting season was observed to continue from the middle of July to the end of August.

Distribution
Throughout India cultivated as well as growing wild, up to an elevation of 1000 m.

Cultivation
For Propagation and cultivation through seeds, the seeds must be ripe and fresh to plant. The dried or shriveled fruits are not viable. One can plant the whole fruit, but it's best to remove the pulp before planting in potting mix that is kept moist but not wet. Stem cuttings can be also used for propagation.

Chemical Constituents
The Murraya koenigii tree contains a carbazole isolated from this plant. Curry leaf contains the amino acid cysteine. The leaves of Murraya koenigii contain proteins, carbohydrate, fiber, minerals, carotene, nicotinic acid, Vitamin C, Vitamin A, calcium and oxalic acid. It also contains crystalline glycosides, carbazole alkaloids, koenigin, girinimbine, iso-mahanimbine, koenine, koenidine and koenimbine. Triterpenoid alkaloids cyclomahanimbine, tetrahydromahanimbine are also present in the leaves.

Bark contains carbazole alkaloids like murrayacine, murrayazolidine, murrayazoline, mahanimbine, girinimbine, koenioline and xynthyletin.

The pulp of fruits generally contain 64.9% moisture, 9.76% total sugar, 9.58% reducing sugar and negligible amount of tannin and acids, besides containing 13.35% Vitamin C. The pulp of fruit also contains trace amounts of minerals, 1.97% phosphorus, 0.082% potassium, 0.811% calcium, 0.166% magnesium, 0.007% iron and remarkable amount of protein.

Carbazole alkaloids which are abundantly present in the leaves, fruits, roots and bark of this plant, have been reported for their antidiabetic, anticancer, antibacterial, anti-nociceptive and antioxidant activities.
Ayurvedic Properties

Rasa: Katu, Tikta, Madhura
Guna: Guru, Rooksha
Virya: Ushna
Vipak: Katu

Medicinal uses
Murraya koenigii is an aromatic stomachic and carminative and is useful in anorexia acute and chronic dyspepsia flatulence and colic. It is often employed to correct the griping pains caused by purgatives. It is used as an antidote for snake bites especially the bites of Kraits.

Useful part: Root, Bark, Leaves
Curry leaf tree (Murraya koenigii L., Family: Rutaceae) is a plant which has various important uses in the traditional system of medicine in Eastern Asia. Based on ethnomedicine, Murraya koenigii is used as a stimulant, antidysentric and for the management of Diabetes Mellitus. The plant is highly valued for its leaves an important ingredient in an Indian cuisine to promote appetite and digestion. The leaves, root and bark are tonic, stomachic, and carminative. Leaves are used internally in dysentery also checking vomittig. Steam distillate of the leaves can be used as stomachic, purgative, febrifuge and anti emetic. Leaves are applied externally to bruises and eruption. The leaves and roots are bitter, acrid, cooling, anthelmintic, analgesic, it cures piles, allays heat of the body, thirst, inflammation and itching. It is also useful in leucoderma and blood disorders. An infusion of the toasted leaves in used to stop vomiting. The juice of the root is good for pain associated with kidney. Crushed leaves are applied externally cures skin eruption and to relieves burn. The pastes of leaves are applied externally to treat the bites of poisonous animals. The plant is credited with tonic and stomachic property. The branches of Murraya koenigii are very popular for cleaning the teeth as datun. It is also said that the branches of Murraya koenigii are used to strengthen gums and teeth’s.

Therapeutic Uses
The bark and the roots are used as a stimulant by the physicians. They are also used externally to cure eruptions and the bites of poisonous animals.

The green leaves are stated to be eaten raw for curing dysentery, and the infusion of the washed leaves stops vomiting.
1. Diabetes: Curry leaf benefits individuals suffering from hereditary diabetes and diabetes caused by obesity. Eat 10 fresh curry leaves daily in the morning for at least three months.

2. Eyes: The juice extracted from curry leaves brightens the eyes and delays cataract.

3. Diarrhea: Drinking the juice of 15-20 curry leaves mixed with a teaspoon of honey serves as an efficient curry leaf for diarrhea.\textsuperscript{[9]}

4. Constipation: Take one teaspoon of dried curry leaf powder with a teaspoon of honey in it. Consume this for about two to three times in a day to get rid of constipation.

5. Nausea: Drinking a cup of water mixed with one tablespoon of roasted curry leaves serves as one of the most effective for nausea.

6. Curry leaf benefits the body by stimulating digestive enzymes, reducing body heat, relieving kidney pain, controlling Diabetes, making the eyes appear brighter, retaining the natural pigmentation of hair,. Curry leaves are known to be good for hair, for keeping them healthy and long.

7. For snake bite poisoning, drink decoction of whole plant with raw turmeric and salt.

8. For skin rashes, boil leaf with cow’s milk and apply paste.

9. For vomiting, leave leaf or root powder to stand in boiling water, strain and drink.

10. For abdominal pain, take leaves, aralu and pepper powder.

**Pharmacological Properties\textsuperscript{[10]}**

<table>
<thead>
<tr>
<th>Pharmacological Activity</th>
<th>Plant part</th>
<th>Extract</th>
</tr>
</thead>
<tbody>
<tr>
<td>Anti-inflammatory</td>
<td>Leaf</td>
<td>Ethanol, Petroleum ether, Chloroform, methanol</td>
</tr>
<tr>
<td>Anti-amnesic</td>
<td>Leaf</td>
<td>Petroleum ether</td>
</tr>
<tr>
<td>Hypocholesterolemic</td>
<td>Leaf</td>
<td>Ethanol</td>
</tr>
<tr>
<td>Memory enhancer</td>
<td>Leaf</td>
<td>Petroleum ether</td>
</tr>
<tr>
<td>Anti-helminthic</td>
<td>Leaf</td>
<td>Alcoholic</td>
</tr>
<tr>
<td>Anti-bacterial</td>
<td>Bark, Leaf</td>
<td>Petroleum ether, Alcohol</td>
</tr>
<tr>
<td>Anti-cancer</td>
<td>Stem bark</td>
<td>Petroleum ether</td>
</tr>
<tr>
<td>Anti-diabetic</td>
<td>Whole plant, fresh leaf, fruit.</td>
<td>Aqueous, methanol</td>
</tr>
<tr>
<td>Antidiarrhoeal</td>
<td>Seeds</td>
<td>n-hexane</td>
</tr>
<tr>
<td>Anti-fungal</td>
<td>Leaf</td>
<td>Petroleum ether, alcohol and acetone</td>
</tr>
<tr>
<td>Radioprotective and chemoprotective</td>
<td>Leaf</td>
<td>Methanol</td>
</tr>
<tr>
<td>Analgesic and Antinociceptive</td>
<td>Leaf</td>
<td>Methanol</td>
</tr>
<tr>
<td>Anti-oxidant</td>
<td>Leaf</td>
<td>Methanol and Aqueous</td>
</tr>
<tr>
<td>Cardiovascular</td>
<td>Leaf</td>
<td>Aqueous</td>
</tr>
<tr>
<td>Anti-lipid peroxidative</td>
<td>Leaf</td>
<td>Methanol</td>
</tr>
<tr>
<td>Anti-tumor</td>
<td>Leaf</td>
<td>Petroleum ether</td>
</tr>
</tbody>
</table>
MATERIALS AND METHODS

Plant collection

The leaves and stem of *Murraya koenigii* were collected in summer season from botanical garden of Dravyaguna department of National instate of ayurveda, jaipur (Rajasthan) in May 2013. Fresh leaves were collected and dried under shade for 15 days, and were powered using mechanical grinder. This powered material was used for further analysis. The plant was morphologically examined for shape of leaves, apex, base, margin etc. A separate section was prepared and examined for the identification of starch grains by staining with iodine solution. The powdered drug was separately treated with phloroglucinol – HCl solution, saffron reagent, glycerin and iodine solution to determine the presence of lignified cells, calcium oxalate crystals and starch grains; as a part of quantitative microscopy. Stomata number, stomatal index, vein islet and veinlet termination number were determined by using fresh leaves of the plant. Total ash, water and alcohol soluble ash, water soluble extractive values were determined.

Leaf Microscopy

The outer epidermal membranous layer (in fragments) were cleared in chloral hydrate, mounted with glycerin and observed under a compound microscope. The presence/absence of the following was observed: epidermal cells, stomata (type and distribution) [F.1] and epidermal hairs (types of trichomes and distribution) [F.2], epidermis (upper and lower), hypodermis, spongy parenchyma [F.3], stomata number, stomatal index, vein islet and veinlet termination number were determined by using fresh leaves of the plant. Xylem elements and ground tissue were also observed under microscope. The transverse sections of the fresh leaves through the lamina and the midrib were also cleared, mounted and observed [F.4].

Stem Macroscopic and Microscopic Examination

Macroscopic examinations

*Murraya koenigii* is an aromatic and small tree up to 6 m in height and 15-40 cm in diameter. The young stems are green in color with sweet aromatic odor and characteristic taste. The outer surface is smooth, soft and glabrous.
Microscopic examinations
The stem of *Murraya koenigii* has a circular transaction and shows following features.

Epidermis
It is single layered, parenchymatous, uniseriate, unicellular, tangentially elongated surrounded by thick cuticle. Epidermis exhibits 5-6 unicellular, uniseriate, covering trichomes [F.5], [F.9].

Oil gland
Just below the epidermis, there are 6-10 schizolysigenous oil glands present [F.8].

Cortex
Continuous strands of 4-6 layers of compactly arranged parenchymatous, polygonal cells constitute the cortex region. The cortex region shows the presence of lignified sclerenchymatic cells [F.5].

Vascular bundle
The vascular system consists of a cylinder of xylem produced towards the cylinder of phloem outward along with bi or triseriate medullary rays. Vascular bundles are of collateral, conjoint and open type [F.6, 7].

Pith
Pith consists of thin walled polygonal, parenchymatous cells bearing starch grains [F.10].

Table 1. Phytochemical screening of bark of *M. koenigii*

<table>
<thead>
<tr>
<th>Phyto constituent</th>
<th>Methanol Extract</th>
<th>Petroleum Ether Extract</th>
<th>Aqueous extract</th>
</tr>
</thead>
<tbody>
<tr>
<td>Alkaloids</td>
<td>+</td>
<td>+</td>
<td>+</td>
</tr>
<tr>
<td>Carbohydrates</td>
<td>+</td>
<td>+</td>
<td>+</td>
</tr>
<tr>
<td>Steroids</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Proteins</td>
<td>-</td>
<td>+</td>
<td>-</td>
</tr>
<tr>
<td>Saponins</td>
<td>-</td>
<td>-</td>
<td>+</td>
</tr>
</tbody>
</table>

Table 2. Physicochemical parameters of bark of *M. koenigii*

<table>
<thead>
<tr>
<th>Parameters</th>
<th>Values obtained</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total ash</td>
<td>10.15% w/w</td>
</tr>
<tr>
<td>Acid insoluble ash</td>
<td>2.8% w/w</td>
</tr>
<tr>
<td>Water soluble ash</td>
<td>3.65% w/w</td>
</tr>
<tr>
<td>Moisture content</td>
<td>9.42% w/w</td>
</tr>
</tbody>
</table>
Recent research
1. Curry leaf extracted in a 1:1 ratio of alcohol to water had the highest level of antioxidant properties, according to the findings of a study published in 2013 in pubmed.\[11\]
2. The Scientist study suggests that M. koenigii leaves to be a potent source of proteasome inhibitors that lead to cancer cell death. Therefore, identification of active component(s) from the leaf extract could lead to the development of anti-cancer agents which could be useful in the treatment of different types of cancers.\[12\]

RESULTS AND CONCLUSION
Generated data can be used for determining correct identity and purity of plants part and detection of adulteration as well. Botanical authentication and physicochemical parameters will give an idea about the quality of drug. All these parameters, which are being reported, could be useful in identification of distinctive features of the drug. From the phytochemical study, it can be concluded that only selected species of Murraya contains the reported phytoconstituents. Hence, detailed screening may be done to isolate the active constituent so that it may be scientifically proved to access the pharmacological responses of the plant to ascertain its folklore uses.

Microscopy of *Murraya koenigii* leaf showing Trichome stained with saffron. [F.2]

Microscopy of *Murraya koenigii* leaf showing outline of TS across midrib stained with phloroglucinol and HCl. [F.3]
Microscopy of *Murraya koenigii* leaf showing outline of TS across lamina.  [F.4]

Microscopy of *Murraya koenigii* leaf showing Stometa stained with saffron.  [F.1]

TS showing medullary rays in young stem

Primary growth of *murraya koenigii* young stem
Transverse section showing xylum and phloem parenchyma cells in young stem

Transverse section showing cuticle, layer of epidermis and oil gland in young stem

Transverse section showing starch granule in pith region in young stem
REFERENCE