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A review: The pharmacological activities of Murraya koenigii Spreng.

Tanvi Kapil[1] Student in Gautam college of Pharmacy, Hamirpur. Pin code 177001.

Priyanka Sharma [2] Assistant Professor in Gautam college of pharmacy ,Hamirpur. Pin .code 177001.

Abstract: Murrya koenigii in English as Karipatta or kadipatta in Nepali as well as Hindi. The biological source of Murraya koenigii is Murraya koenigii spreng and it belonging family Rutaceae. It was found in Himalayas, Maharashtra, Tamilnadu, Andhra Pradesh, Assam, Andaman and Nicobar island. It is one of the main component of formulation in the traditional ayurvedic system of Medicine many centuaries. It is used in the treatment of many disease including kidney stone, dysentery disorder, renal pain, stomach upset and morning sickness. Blood purifier. The leaves , roots and bark of this plant are rich in source of carbazole alkaloid. Different part of the plant are used in Leaves, Stem, roots, fruit and seeds that is used to provide the strengthening of immune system. There are various Pharmacological activities are. Anticancer,anti diabetic, antibacterial, antitumor, antihelmintic, antioxidant and hepato protective properties. The curry tree is having many disease protecting ingredients which can be used as natural source to make newer, alternative and innovative medicines. The leaves are used traditionally as a spice in curry and other eatables. Plant have been used in traditional medicine for several thousand years. Curry leaves used traditionally as blood purifier, febrifuge. World about 80% population relies upon herbal product because they have been considere as safe effective and economical. Medicinal plant are used in herbalism and thought to have some medicinal properties. They are easily available source for health care purpose in rural and tribal area. Ethanobotany is a distinct branch of natural science dealing with various aspect such as anthropology, archaecology, botany, economics and medicine religious, cultural and several other discipline.

Keywords.

Murraya koenigii, Anticancer, Antioxident, Antihelmintic, Hepatoprotective.

Introduction:

Murraya. Koenigii spreng belonging to family Rutaceae and it is usally known as M. koenigii is referred to as karipatta or kadipatta in Hindi and Nepali. Different parts of the plant are used like leaves, stem , root, fruit, and seeds that is used to provide strengthing immune system It was found in Himalayas, Maharashtra, Tamilnadu Andhra Pradesh , Chittagong, karnatka, Assam, Andaman and Nicobar island Different biological properties of M.Koenigii possess Anti- Inflamatory, Antibacterial, Antidiabetic, Antioxident and anti- protozoal properties[Gunjan P. malode et.al. 2021]. Curry leaves contain many important ingredient like carbohydrates, protein, fiber, calcium, phosphorous, iron, magnesium, copper, mineral and vitamin like nicotinic acid, nutrients B, C, A, and E, Flavonoids, glycosides, plant sterols, and antioxidants. Murraya koenigii boiled with coconut oil to condensed to residue that are used as dominant hair tonic for retaning and maintaining of natural hair tone , hair stimulation and prevention of premature growing hair[DR Priyanka Gupta 2020]. The oil is applied externally for blisters, eruptions, and in the fragrance and soap industries Murraya koenigii is a semi-evergreen aromatic tree used for febrifuge, analgesic, and skin eruption purposes.It is a staple in Indian dishes and is well known for its subtle flavor and used confidently in daily cooking The british were India they called it curry leaf naming after the seasoned sauce it was added to Murraya koenigii possesses a lot of bioactive principles, which have made it a valuable medicinal plant, but scientists haven't given it much thought[Rajendran MP2014]. Murraya koenigii is proven as natural medicinal plant. The leaves of the plant have been used in Indian Cuisine and also used for centuries in the Ayurvedic system of medicine. The bark is helpful in treating snakebites[Kang w 2018]. The tropical subtropical region in the world have large distribution of M. Koenigii [Harish KH,2012].Murraya koenigii Leaves are slightly bitter in taste, pungent in smell, and weakly acidic Various part of M. Koenigii are used to treat diabetic, chronic, dysentery, fever and diarrhea[Amit Choudhary 2020].The leaves of M. Koenigii are used traditionally to treat toothache and teething issues in babies, skin irritation caused by scabies and remedy for stomachache and headache [*Coun Sci & Indus Res*. 1962;6:125–127].Leaves and roots of C. Indica treat various health issue, such as flu, cold, joint dislocation, bone fracture, headache, colic and rheumatism, C Indica fruit are widely used in Vietnam and south Indian cooking mainly due to their aroma[Himadri Shekar Datta 2023].

Common Name: [16, 19].

Table 1

Sr.no.	Language:	Vernacular Name:
1.	English:	Murraya koenigii
2.	Hindi:	Curry patta, Meetha Neem, Kathnim.
3.	Marathi:	Karipat, Karhipatta, Karhinimb.
4.	Kannanda:	Karibevu
5.	Tamil:	Karivempu, Karuveppilei, Karivepila
6.	Malayalam:	Kariveppilei, Kareapela.
7.	Sanskrit:	Girinimba, Suravi.
8.	Telugu:	Karepaku, Karuvepaku.
9.	Gujrati:	Mitholimdo
10.	Bengali:	Barsunga

Parts of Plants:[17,18]

Table 3.

Sr.no.	Part of plant:
1.	Leaves.
2.	Stem.
3.	Roots.
4.	Seeds.
5.	Fruit.
6.	Essential oil.

Taxonomical Classification: [15,16.]

Table 2.

Sr.no.	Taxonomical Classification:
1.	Kingdom: Plantae
2.	Subkingdom: Tracheobionta
3.	Sub class: Rosidae
4.	Order: Spindales
5.	Family: Rutaceae
6.	Genus: Murraya J. Koenig ex L.

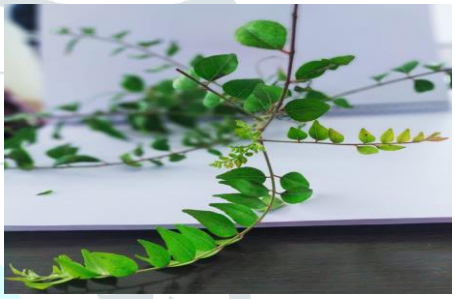
Chemical Composition:

Part of plant:	Chemical composition:
1.Leaves.	Alkaloid, Antioxident, sterols, resin, ethanol, ethyl acetate, water, choloform petroleum ether, protein, carbohydrate, minerals, vitamin B, Vitamin C, oxalic acid, carbazole[Drisya CR 2013].O-phellandrene, P- gurjuneare [Handral HK 2010]. Alpha piene, Beta piene, Beta caryophyllene, koenimbine, koenigine, coumarine, girinimbine, phebalosin, mahanimbicine, bicyclomahanimbine, isomahanimbin found in parts of plant like root leaves and bark[Ito C. 2000].ascorbic acid, tannic acid , mineral like phosphorous, iron, calcium, potassium, magnesium, isobyakangelicol, xanthotoxin, furocoumarines[Rao BRR 2011]. Caryophyllene, dipentene, di- alpha phellandrone, D- Alpha terpinol, D- Sabiene[Rana VS 2004].Total sugar(18.92%), nitrogen(1.15%), starch content(14.6%), fat content(6.15%), moisture content(63.2%), crude fiber(6.8%), acid insoluble(1.35%), ash content(13.06%), cold water(27.33%), alchol soluble extract (1.82%), hot water soluble extractive(33.45%), carbohydrates, protein , fiber, fat [Igara CE2016]. Volatile oil, carotenoid, carbazole alkaloid [Ganesan p 2013].bispyrayafoline, bismahanine, isomahanine, o- methyl murryamine o- methyl murrayamine, o- methyl mahanine, glycozoline, 1- formyl- 3 methoxy- 6 methyl carbazole, 6,7- Dimethoxy 1- hydroxy- 3 methyl carbazole [Chowdhury BK2001].
2. Stem	Quinone A, Koenigine quinone B, 7- methoxy- 3 methyl carbazole, 1,4- quinone, 6-7- dimethoxy 3- methyl, carbazole 1, 4 quinine, 9 carbethoxy 3 methyl carbazole, 9- formyl -3- methyl carbazole [Prajapati ND2003]. 2- methoxy carbazole, Mukonal, pyranocarbazole alkaloid, Murrayazolinol, mahanimbinol, murrayazolidine, murrayacinine, mukonidine, murrayazoline, murrayacinine, mukonidine, murrayazolinine, murrayanine, girinimbine, mahanimbine, girinimbinol, mahanimbilol, girinimbine[Parul S2012, Mhaskar KS2000].
3. Roots	Mukoline, girinimbine, marmesin-1-O- rutinoside, mukolidine, murrayanol, three monomeric, five binary carbazole alkaloid, koenoline (1- methoxy-3-hydroxy methyl carbazole[Malwal M 2011],
4. Seeds	Petroleum ether, koenimbine, girinimbine, mahanimbine, mahanine, isomahanine [Tiwari P2011]. 2- methoxy- 3- methyl carbazole, koenimbine, koenine, kurryam [Sayar K2014].Xanthotoxin, isobyaknagelicol, byakangelicol, isogosferol, isoheraclenin, isoimperatonin, oxypeucedanin, isopimpinellin, bergapian, indicolactone, anisolactone, 2,3 epoxyindicolacolactone[Shrinivasan K2005].

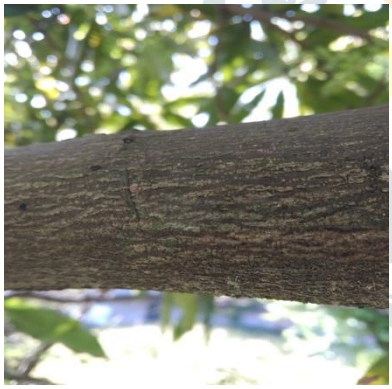
5. Fruit.	Carbazole alkaloid, koenimbine, girimbine, mahanimbine, mahanine, isomahanine, murrayazolidine, murrayanol [kumar B 2011].
6. Essential oil.	Apiene (51.7%)[Olubunmi A2001]. Sabiene (10.5%), betapiene(9.8%), beta caryophyllene(5.5%), limonene(5.4%), bornyl acetate(1.8%), terpinene- 4- ol(1.3%), a-humulene(1.2%), g- terpinene(1.2%), [35]. Sesquiterpenoid followed by 34.4%, monoterpenoid, beta caryophyllene (35.8%), alpha caryophyllene(9.17%), selinene(8.88), cardinene(8.43%), beta thujene (41.2%), trans ocimene (3.12%), beta-phellendrene(2.57%), gujunene(1.46%), linalool (0.27%), alpha pinene (0.26%), beta elemene(0.18%), Hydrodistilation of fruit (0.13%), caryophyllene oxide(10.3%), b- caryophyllene(8.5%), tridecanoic acid (8.2%), terpinene- 4- ol(8.0%), dehydroaromadendrene (8.0%), a- cadinol (7.3%), Z,E- Farnesol (5.7%)[Rageeb MD et.al.2012].

Figures:

a.



b.



d.

c.

figure 1. a) flower. b) leaves. c) stem. d) root.

Pharmacological Activity:

1.Antioxident Activity:

Because of its antioxidant action, the Murraya Koenigii leaf extract significantly protects rat cardiac tissue from oxidative stress caused by cadmium [Ashwini Y. Parbat 2021] . Murraya koenigii leaves were observed to have highest antioxidant [Ayushi Sharma et.al.2020]. Potential when compared with four other leafy vegetable[B. Maheswari Reddy, et.al. 2018].Mahanimbine and koenigine carbazole alkaloid isolated from the leaves of Murraya koenigii showed antioxidant activity[Suman singh, et.al. 2014].The Murraya Koenigii leaf extracts made with various solvents were assessed using the oil stability index The curry trees barriers may be good natural source of antioxidant[Hemant Dhongade et.al. 2013].Compound to prevent oxidative damage of meat product[Prasan R Bhandari et.al.2012].The alteration seen in the levels of lipid peroxidation reduced glutathione Protein carbonyl content, changes is the activities of cardiac antioxidant And pro-oxidant enzymes, indicate that cadmium induced issue damage The Leaf extract of Murraya Koenigii have high Antioxident activities[Kusuma J.W.; et.al. 2011]. An 80% scavenging activity was demonstrated by the ethanolic extract of M. Koenigii, which was comparable to the activity displayed by the control antioxidant component quercetin [Ramalakshmi k; et.al.2007].After isolating five carbazole alkaloids from Ch2cl2 extract extract, their structures were determined using 1H and 13c NMR and mass spectral data These compounds were identified as euchrestin, bismurrayafoli, Mahanine, mahanimbicine, and mahanimbine [Tachibana Y,et.al. 2001].Murraya Koenigii might be potent and novel .Therapeutic agent for scavenging caused by excessive generation of NOAnd its oxidation product peroxynitrite[Baliga MS et.al. 2003].

2. Anti- Inflamatory Activity:

Tissue injury cell damage infections due to pathogens and alteration in biochemical leads to a biological response called inflammation[Dhanraj vijayraja et.al.2019]. It has been observed that bioactive compounds such as Murraya konine A, O-methylmurrayamine A, and mukolidine are effective at inhibiting TNF alpha Furthermore, LPS-induced IL-6 release in human peripheral blood mononuclear cells caused inflammation [Nali,Y.;et.al.2016].The leaves of Murraya koenigii was subjected to extraction with three various solvent Petroleumether, carbazole[Muthulinggam Nishan et.al.2015]. M. Koenigii In male albino rats, leaves significantly promote wound contraction and decrease epithelialization to prolong wound healing[Parimi BN et.al. 2014,52Manfo FPT et.al.2014].The Anti- inflammatory activity of an M. Koenigii leaf extract in Carrageenan induced paw edema [Darvekar et.al.2011].Three solvent was found that ethanolic extract show significant reduction In carrageenan induced paw edema in the albino rat of the wister strain [Gupta S et.al. 2010] .The important component involved in inflammatory processes are believed to mast cells, ependymal cells, microglia, astrocytes, and macrophages[Bashkatova et.al.2004].

3.Anticancer Activities.

According to Samanta's review, mahanine is a significant anti-cancer bioactive chemical found in M. koenigii[Samantaa SK et.al.2018]. It has also been shown that mahanine and isomahanine have anticancer properties in human oral squamous cell carcinoma CLS-354[Utaipan et.al. 2017]. With an IC50 of 14.4 ug/ml, total alkaloid isolated from Koenigii leaves has demonstrated promising cytotoxic action in breast cancer [Ismail et.al. 2016].Methanolic extract of M. Koenigii was reported to have ability to reduce Proliferation in breast cancer cell lines[B Ajumeera et.al.2013]. A carbazole and girinimbine were extracted from Murraya koenigii's bark The induction of significant programmed cell death in HepG2 cells implies the need for additional assessment in preclinical models of human hepatocellular carcinoma[Syam S et.al. 2011]. The involvement of death receptor medicated extrinsic pathway of Apoptosis in mahanine- induced anticancer activity in MOLT-3 cell But not in K562 cells which are deficient in Fas/ Fasl [Bhattacharya K et.al.2010]. Murraya koenigii hold as an immunomodulatory agent by stimulating Humoral immunity and phagocytic function [Shah AS et.al.2008.]. Three carbazole alkaloid Mahanine pyrafoline and murraya foline showed significant activity aga HL- 60 cells by inducing apoptosis through capsase- 9/ capsase- 3 pathway Through mitochondrial dysfunction[Nakao K et.al.2006]. The Down regulation of survival cell Factor by activation of capsase- 3 through mitochondrial dependent Pathway and disruption of cell cycle progression could be an additionalMechanism[Roy MK et.al.2004]. It have also been seen on intestine and colon cancer using Animal model and treating them extraction of leaves [Khan BA et.al.1996.].

4. Anti- Bacterial Activity:

The essential oils from Murraya koenigii leaves showed an anti-bacterial Effect against Corynebacterium pyogenes, streptococcus aureus, Bacillus subtills Pasteurella and proteus Vulgaris[Anjana Goel et.al.2020]. Methanol and ethanol extract of Leaf extract from M. Koenigii was found to be efficient against Escherichia coli, Staphylococcus, Streptococcus, and Proteus bacteria[Qais et.al.2019].Pyracarbazole isolated from M. Koenigii exhibited antibacterial activity on bacterial strain of Staphylococcus aureus and klebsiella pneumonia[Joshi et.al.2018]. Gas chromatography mass spectroscopy revealed the presence of antibiofilm compounds such as spathulenol (5.85%), cinnamaldehyde (0.37%), and linalool (0.04%)[Rai Vittal et.al.2015] . M. koenigii ethanol extract exhibited significant Synergistic antibacterial activity against Mycobacterium smegmatis and Mycobacterium Bovis Bacillus Calmette Guerin in combination with anti- tuberculosis drug rifampicin [R. Sonawane et.al.2014]. The SFM Essential oil at 300 microgram/ ml provide 92% Inhibition indication its potential as a natural anti- microbial Agent [Erkan N et.al. 2012] .T he essential oil derived from M. koenigii leaves demonstrated antibacterial activity against Pasteurell Multicide, B. Subtilis, Staph, Aureus, C. pyogenes, and P. vulgaris[Ajay S et.al. 2011].The acetone Extract of the fresh leaves of M. Koenigii on fractionation gives Three bioactive carbazole alkaloid Names as mahanimbine, murrayanol and Mahanine which has mosquitocidal, antimicrobial and Topisomerase 1 and 11 Inhibition activities [Narasimhan NS et.al. 1975]. The pure oil was active against the first three Organism even at a dilution of 1: 500 [Goutam MP et.al.1974].

5.Antifungal Activity.

The antifungal activity against Candida tropicalls Candida albicans, Aspergillus Fumigates Aspergillus niger Micro sporumgypseum was observed by the extract of Murraya koenigii leaves[Sunanda Kulshreshtha et.al.2020] Pencillium notatum, Aspergillus Flavus, Aspergillus niger, Fusarium moniliforme, Mucor Mucedo, Pencillium funiculosum etc were isolated from infected sapling and spoiled foods based on alteration of their growth characterstic mycelial morphology and spore morphology[Tripathi et.al. 2018]. M. koenigii were administered at a dilution of 1:500 It exhibited antifungal activities against microsporum gypseum ,Aspergillus niger, Candida albican and c. Tropical [Arya N et.al. 2017]. The aqueous and ethanolic extract failed to show any kind of anti-fungal or anti-candidal effect [Sivakumar CHV et.al.2013].The methanolic and ethanolic extract were found effective against mycelia growth in Rhizoctonia salani and fusarium oxysporum with different effiency[Rajnikant et.al. 2011]. Murraya koenigii leaves essential oil demonstrated antifungal efficacy against Candida albicans, Candida tropicalis, Candida niger, Candida fumigatus, and Microsporum gypseum [P.Uma Devi et.al. 2008].When compared to the 30 candida albicans, the ethanolic extract of M. Koenigii was tested for anticandidal activity; however, no extract showed any anticandidal activity [Vijayanthimala et.al.2000]. The ethanolic extract of the leaves showed fungitoxicity against Colletotrichum falcatum and Rhizoctonia Solani[Kishore N et.al. 1982].The ethanolic extract of the entire plant, with the exception of M. Koenigii's roots, did not, however, exhibit any antifungal action against Trichophyton mentagrophytes, Microsporum canis, or Cryptococcus neoformans [Singh L et.al. 1978].The antifungal activity of M. Koenigii has been reported in various studies, for example the essential oil of the leaves were reported to possess antifungal activity [M.P. Purohit et.al. 1974].

6. Anti-ulcer Activity:

The extract produced inhibition of gastric lesion induced by anti-inflammatory, non steroidal drugs and pylorus ligation model[Ayushi Sharma et.al. 2020] The Antiulcer activity was observed using aqueous extract at doses of 200 and 400 mg / kg [B.V.S. Lakshmi et.al. 2018].The model of acute stomach lesions caused by ethanol-induced aspirin-induced, cold restraint stress, and pylorus ligation rats was used to assess the anti-ulcer efficacy of the leaf aqueous extract[Harish K et.al. 2012] .These observation provide a confirmation about aqueous extract of leaves of M. Koenigii can act as good anti-ulcer activity[Praveen Sharma et.al. 2011].Antiulcer activity of aqueous and ether extract of M. Koenigii was investigated in a model of reserpine-induced gastric ulcers in albino rats; the extract shown to be equally protective against gastric ulcers as ranitidine [Annie Shirwaikar et.al. 2006]. The extract reduced gastric volume ulcerative lesion, free and total acidity but an elevation in the PH value of gastric juice in pylorus ligation model was formed [Kumar VS et.al. 1999].

7. Immunomodulator Activity:

The leaf extract do not only have antidiabetic property but it also assured to control immunology relieve to oxidative stress metabolism[Jagdish V Manwar et.al. 2021].The immune system make a network and regulates processes important for maintaining the health of an organism by hindering the entry and invasion of microbes[Palanivel Ganesan et.al.2020].The methanolic extract of M. Koenigii showed a significant increase in phagocytic index by rapid removal of carbon particle from blood stream[C.K. Dhanpal et.al.2015].Impairment in the immune system lead to condition from chronic inflammation to cancer[Kaufmann et.al. 2015]. This immunomodulatory and anti-inflammatory activity was evident by interleukin(IL) 2,4,10 and tumor necrosis factor alpha expression[Paul S et.al. 2011].

8. Anti-protozoal Activity:

.The ethanolic extract of Murraya koenigii showed antiprotozoal action, antipasdomic activity, and antihypertensive activity against Ent histolytical[DR Priyanka Gupta 2020].The pharmacological activities of an ethanolic extract of the entire Murraya koenigii plant, omitting the roots, and the roots alone, were examined A Protozoal action against Ent Histolytica, antispasmodic effect on isolated guniea pig ileum, whereas extract show antiprotozoal activity against Ent[Ajay S et.al.2011].Histolytica as well as antihypertensive activity in cat/ dog [Bhakuni DS et.al. 1969].

9.Anti-helmintic Activity:

Synthetic antihelminth drugs, such as oxyclozanide, niclosamide, and bithionol, impede the production of energy by disabling oxidative phosphorylation upon tannin binding to free protein in the gastrointestinal tract of the host and glycoprotein on the parasite's cuticle[DR Priyanka Gupta 2020].The antiobesity and antihyperlipidemic activities of these extract are correlated with a carbazole alkaloid mahanimbine[B Maheswari Reddy et.al. 2018].The leaves of Murraya koenigii poses as antihelmintic effect by which the ethanolic and aqueous extract of the leaves show antihelmintic effect against pheretima posthuman and the both extract was comparable to the standard

drug piperazine [Muthulinggam et.al. 2014].The earthworm is caused by addition of methanolic extract of leaves at a time period of 18 min and lethal effect at a time period of 45 min [Prabhu KA et.al. 2012]. Additionally, the methanolic extract has dose-dependent antihelmintic efficacy against Indian earthworms, perhaps paralysing them.18 minutes can have a deadly and deadly effect 45 minutes [Dora J et.al. 2011]. The tannin work by following uncoupling oxidative phosphorylation and further disrupting the energy generation by free protein and glycoprotein binding to the host gastrointestinal tract on parasite cuticle leading fatal for the parasite[Dinesh kumar B et.al. 2010].

10. Anti-pyretic Activity:

After administering brewer's yeast to the rats to induce fever, it was discovered that the ethanol extract of M. Koenigii leaves had antipyretic properties[Gunjan p. Malode et.al. 2021].Alcoholic extract of murraya koenigii had significant anti- pyretic activity effect in PGE1 induced hyperpyrexia in rats[Pokla N et.al. 2019]. The rat were fevered by the parental administration of Brewer,s Yeast at the dose of 10 mg/ kg[Bhavik Chauhan et.al. 2017].The petroleum ether extract and chloroform extract with paracetamol dose as a standard drug[ageeb MD et.al. 2012].The ethanolic extract of Murraya koenigii is a significant antipyretic activity using yeast induce pyrexia in rat model [Patel MG et.al. 2009].

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