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VALIDATION OF THERAPEUTIC POTENTIAL OF *MORINGA OLEIFERA* LAM. THROUGH REVERSE PHARMACOLOGY

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ABSTRACT

Moringa oleifera Lam. (*Moringaceae*), commonly known as drum stick plant is an important drug of Pharmacoepia of Ayurveda. All parts of the plant viz. Root bark, stem bark, leaves, flowers and fruits are used in therapeutics in Ayurveda. It is also reputed in folk medicine world over for its therapeutic potential. It is a rich source of various nutritional components also. It also has been a focus drug for researchers in modern era and a large number of pharmacological and clinical studies have been carried out for the evaluation of therapeutic efficacy of various parts of the plant in preclinical and clinical studies. Present paper is an attempt towards validation of therapeutic potential of various plant parts through reverse pharmacology.

KEYWORDS: *Moringa oleifera* Lam., Ayurveda, folk Medicine, therapeutic potential, reverse pharmacology.

INTRODUCTION

Moringa oleifera Lam., reputed by the name of *Shigru* in Ayurveda, commonly known as Horse-raddish tree or Drum-stick plant belongs to the family *Moringaceae*. It is indigenous to sub Himalayan tract and commonly cultivated throughout the country. In tropical and subtropical areas, seed, pods and the leaves are used as vegetables. Due to white colour of seeds and similarity to *maricha* (*Piper nigrum* L.) in appearance, it is also known as *shveta maricha*. Properties and actions of *shigru* are *svedopaga* (Co-diaphoretic), *krimighna* (Anthelminthic), *shirovirechana* (Sub-errhine) and *vedanasthapana* (Analgesic). The drug is

used for internal abscess and wounds. It is externally applied for alleviating spasms of legs. An antibiotic substance pterygospermin has been isolated from the roots. It exhibits high activity against gram positive and gram negative bacteria including *Mycobacterium tuberculosis* var. *hominis*, pathogenic moulds and fungi.

Botanical description[1]

A Small or medium sized tree, growing upto 10m. **Bark** grayish, corky with longitudinal cracks, profusely exuding a gummy substance on injury. **Leaves** alternate, tri-pinnately compound, 30-40 cm long, longer in vegetative condition, pinnae 4-6 pairs and odd one, pinnules 3-4 pairs with an odd one; the terminal one obovate and larger. **Flowers** white, sweet scented, 2.5 cm across. Fruit an elongated, bluntly 3 angled pod, 30-60 cm long and 1.5 cm thick, loculicidally 3 valved. Seeds many 3 angled and 3 winged.

Distribution and habitats

Plant is indigenous in sub-Himalayan tract. It is commonly cultivated throughout the country. Plant is found in Assam, Gujarat and Uttar Pradesh. It grows almost throughout India up to lower elevation in hilly regions.

Phytochemistry[2]

The root-bark contains moringine alkaloids, **Root –** An antibiotic principle, pterygospermin along with three alkaloids moringine, moringinine siprochin, aurantiamide acetate and 1,3-dibenzylurea were isolated from the root. **Analysis of leaves** A water-soluble alkaloid trigonelline, A number of polyphenols (quercetin and kaempferol), gallic acid, chlorogenic acid, ellagic acid and ferulic acid from the leaves. **Seeds** campestenol, stigmasterol, clerosterol, B-sitosterol, Sterols viz., campesterol, AS-avenasterol, A7-avenasterol, 28-isoavenasterol, 24-methylenecholesterolandstigmasterol and fatty acids viz., palmitic, stearic, oleic, linoleic and arachidic were found in the seed oil. Butanol extract of seeds also yielded B-sitosterol. **Pods** contain moisture 86.9, protein 2.5, fat 4.8 and mineral matter 2.0%, calcium 30, phosphorous 1.10, and iron 5.3mg/100g., copper (3.1µg/g.) iodine (18µg./kg.) and oxalic acid (0.01). Pods also contain carotene (as vitamin) 184 I.U., nicotinic acid 0.2 mg. and ascorbic acid 120 mg./100g. Pressed juice of the Pods contains ascorbic acid oxidase. Pods contain a globulin and a prolamin. The Pods are remarkably rich in free leucine.

Table 1: Nutritive value: (all the value expressed as per 100 gm of edible portion).[3]

Parts	Protein (gm)	Fat (gm)	Minerals (gm)	Fibers (gm)	Carbohydrates (gm)	Energy (Kcal)	Calciu (mg)	Phosp. (mg)	Iron (mg)
Leaf	6.7	1.7	2.3	0.9	12.5	93	440	70	0.85
Fruit	2.5	0.1	2.0	4.8	3.7	26	30	110	0.18
Flower	3.6	0.8	1.3	1.3	7.1	50	51	90	-

Table 2: Vitamin contents (all the value expressed as per 100 gm of edible portion).

Parts	Carotene (µg)	Thiamine (mg)	Riboflavin (mg)	Niacin (mg)	Total B6 (mg)	Folic acid (µg)	Vitamin C
Leaf	6780	0.06	0.05	0.8	-	-	220
Fruit	110	0.05	0.07	0.2	-	-	120

Table 3: Minerals and trace elements (all the value expressed as per 100 gm of edible portion).

Parts	Mg	Na	K	Cu	Mn	Mo	Zn	Cr	S	Cl
Leaf	42	-	259	0.07	0.37	-	0.16	0.010	137	423
Fruit	28	-	259	0.01	0.05	-	0.16	0.003	137	423

Table 4: Essential amino acid (all the value expressed as per g N).

Parts	Arg	His	Lys	Trypt	Phe.ala	Meth	Cys	Thr	Leu	Isolu	Val
Leaf	380	140	320	100	290	110	130	250	460	280	350

Moringa oleifera in Ayurveda Classics

In Charaka Samhita, *Shigru* has been classified in *Krimighna* (a group of drugs used for the treatment of worm infestation)[4], *Shirovirechanopaga* (adjuvant in sudation therapy)[5], *Katukaskandha* (a group of pungent drugs)[6] *and Haritakavarga* (group of green vegetables)[7]*;* in Sushuruta Samhita in *Varunadi Gana* (group of drugs having *Varuna* – Craeteva nurvela, capparidaceae as main drug)[8], *Shirovirechan Dravya* (errhine)[9], *Katu verga* (a group of pungent drugs)[10], *Tail Varga* (a group of fixed oil)[11], *Shak Varga* (group of green vegetables)[12]*;* in Ashtanga Hridaya *in Shirovirechan Dravya* (errhine).[13]

Table 5: M. oleifera in Nighantu Classics.

Nighantu	Uses
Raja Nighantu [14]	*Mukhjadykara, deepana* (Useful for stimulating digestive fire), *vranadoshnuta,*
Bhavprakash Nighantu [15]	*Sangrahi, shukrala*(semen promoting), *hrdhya* (Wholesome for heart), *cakshusya* (Beneficial for eyes), *vidradhihara*(pacifies abscess), *sothahara* (Anti-inflammatory), *kramihara* (Antihelmintic), *medohara*, pacifies *apaci* (Chronic lymphadenitis), *plihaghna*, *gulmanashaka* (Destroying the abdominal lump),
Dhanvantari Nighantu [16]	*Sophahara* (Anti-inflammatory), *kramihara* (Antihelmintic), *medohara, vidradhihara, plihaghna, gulmanashaka* (Destroying the abdominal lump)

Table 6: Vernacular names.

Classical (Sanskrit) Name	***Shigru, Shigru, Shobhanjana, Tikshnagandha, Mochaka.***
Hindi	*Sahijan, Munaga*
English	Horse-raddish tree, Drum-stick plant
Bengali	*Shajina*
Punjabi	*Sohanjana*
Gujarat	*Saragavo, Sekato*
Marathi	*Shevaga, Shegata*
Maharastra	*Shegata*
Telugu	*Munaga*

Etymological Derivation of Synonyms of *Shigru*[17]

- *Shigru* – With pungent smell and taste.
- *Akshiva* – Used as anti-narcotic.
- *Mochaka* – It is useful in many disorders.
- *Shobhanjana* – It is a beautiful tree.
- *Krishnagandha* - With pungent smell and taste.
- *Tikshnagandha* - With pungent smell and taste.
- *Ghanachchhada* – Having dense and luxuriant foliage.
- *Bahalapallava* - With pungent smell and taste.
- *Tikshnamula* - With pungent smell and taste.
- *Bahumula* – It has many roots.
- *Murangi* – Known as murangi.
- *Mulakaparni* – With pungent smell.
- *Vidradhighna* – Posesses anti-biotic property and is useful in infective disorders like abscess.
- *Haritashaka* – Leaves and also fruits are used as green vegetable.

Varieties[18]

There are two varieties of *Shigru* mentioned in classical texts on the basis of flower colour viz. white (*Shveta*) and red (*Rakta*) which are bitter and sweet (*katu-madhura*) in taste and they are specifically known as *Katushigru* and *Madhushigru*, respectively. ***Katushigru*** botanically identified as *Moringa oleifera* Lam., occurs almost throughout country. ***Madhushigru***, botanically identified as *Moringa concanensis* Nimmo. is comparatively scarce in occurrence with restricted distribution, for the instance, in Bengal, Rajputana, Sindha and certain other areas including dry hills of Konkan, Andhra Pradesh and

Coimbatore. Leaves bi-pinnate, somewhat longer than those of *Moringa oleifera* Lam. and flowers pinkish yellow in colour in case of later species (*M. concanensis* Nimmo). Various parts of the plant are considered useful as that of *M. oleifera* Lam. Practically the tree of *Moringa concanensis* Nimmo resembles with *M. oleifera* Lam. Another (or third) kind of *Shigru* is ***Nilashigru*** (blue variety) in texts of materia medica (*Nighantu*). The medicinal properties of these kinds of *Shigru* or *Shobhanjana* are also specified in textual sources of medicine.

Pharmacodynamics[19]

Rasa-Katu (Kshariya), Tikta; Guna - Laghu, Ruksha, Tikshna; Virya – Ushna; Vipaka – Katu; Doshakarma – Kaphavatashamaka.

Classical uses of *Shigru*[20]

1. Hiccough and asthma

1. Soup of the leaves of *kāsamarda* (*Cassia occidentalis* Linn, *Leguminosae*) and *śhigru* and of dry radish alleviate hiccough and asthma. (CS.Ci.17.99)
2. Soup well prepared of *shigru* fruits with *marica* (*Piper nigrum* Linn, *Piperaceae*), salt and *yavakşara* (Potasii carbonas) checks hiccough and asthma, (CS.Ci. 17.98)

2. Udara Soup of *shigru* mixed with *pippali* (*Piper longum* Linn, *Piperaceae*), *rocksalt* and *citraka* (*Plumbago zeylanica* Linn, *Plumbaginaceae*) and added with oil is useful. (SS.Ci. 14.13: also VM. 37.46).

3. Colic

1. Pills made of rocksalt, borax and *sunthi* (*Zingiber officinale* Rascoe, *Zingiberaceae*) with *shigru* juice remove colic (SB 45,14).
2. Decoction of *sunthi* and *shigru* alleviates colic within three days. (VM 8 21).
3. Decoction of *shigru* root added with *marica, yavaksära* and honey removes colic caused by *kapha.* (HS Ci. 3.7.48)

4. Oedema - *Shigru* is useful in erysipelas, oedema, piles and skin diseases (CS.Su,1 .117).

5. Erysipelas - Warm paste of *shigru, karañja* (*Pongamia pinnata* Pierre, *Leguminosae*) bark, dried radish or *bibhitaka* (*Terminalia bellirica* Roxb, *Combretaceae*) should be applied. (AH.Ci. 18.25).

6. Guinea Worm - Paste of the root and leaves of *shigru* pounded with sour gruel and added with salt destroys guinea worm. (VM 55.19).

7. Calculus - Soup made of the paste of *šhigru* root 40 gm. fried in ghee and oil and added with curd-scum and salt should be taken cooled in sufficient quantity. (CS Ci. 26.66.67; also AH. Ci. 11.31).

8. Scrofula

1. The seeds of *śhigru* should be taken as pressed snuff. (SS Ci 18.23).
2. *Sobhañjana* and *devadāru* (*Cedrus deodara* Rosb., *Pinaceae*) are pounded together with sour gruel. This paste is applied warm in scrofula. (VM.41.22)

9. Vidarika - The paste of *shigru* and *devadaru* (*Cedrus deodara* Rosb., *Pinaceae*) controls *vidarika*. (VM.57.4)

10. Abscess

1. Decoction of *shigru* mixed with *hingu* (*Ferula narthex* Boiss., *Umbelliferae*)and rocksalt and taken every morning alleviates abscess. (VM. 43.10).
2. Fomentations and poultices should be applied with *shigru* root. (VM.43.3).
3. Intake of the juice of *shigru* root with honey removes internal abscess. (VM 43.11).
4. For internal abscess, decoction of *punarmava* (*Boerhaavia diffusa* Linn., *Nyctaginaceae*) and *varuna* (*Crataeva nurvala* Buch-Ham., *Capparidaceae*)or of *śhigru* added with *hingu* and rocksalt should be taken. (SG.2.2.128)

11. Earache

1. Juice of *shigru* mixed with honey, oil and rocksalt removes earache. (CD.57.5).
2. Juice of *shigru* mixed with *tila* oil and slightly heated should be filled into the ear. It removes earache. (VM. 59.6)

12. Eye diseases

1. Juicc of *shigru* leaves mixed with honey removes many diseases of eye caused by *doşas* separately or jointly. (AH.U.16.9)
2. Washing with the juice of *shigru* leaves alleviates all diseases of eye. (VM 61.40)
3. Juice of *shigru* leaves rubbed well in a copper vessel and fumigated with ghee removes swelling, irritation, watering and pain. (AH.U. 16.37. also VM. 61.40).
4. Lump made of *shigru* leaves is useful in conjunctivitis caused by *kapha.* (SG. 3.13.27).

13. Piles - The patient, well uncted, should be given tub-bath with decoction of the leaves of *agnimantha* (*Premna mucronata* Roxb., *Verbenaceae*) *śhigru* and *aśmantaka* (*Ficus rumphi*, *Moraceae*). It removes pain. (CS.Ci.14.45)

14. Kuştha - In leprotic wounds, oil of *karanja, sarsapa* (Brassica campestris, *Cruciferae*), *Sigru* or *käsamarda* should be applied. (SS.Ci 9.53)

15. Loss of consciousness - The patient should be given snuff with the juice of *shigru* root and *marica* combined. By this consciousness is restored in conditions like typhoid fever, (HS.3.2.33).

16. Headache - Headache is removed by the snuff of *shigru* juice mixed with jaggery. (HS.3.40.21).

17. Worms - Decoction of *shigru* and *vidang* (*Embelia ribes* burm., *Myrsinaceae*) mixed with honey act as antihelmintic. (BS. krimi.22).

18. Vatarakta(Gout) - Application of the paste of *shigru* and *varuna* made with sour gruel removes pain. (BS.vātarakta. 68)

19. Chest-pain - Warm juice of *śhigru* mixed with *hingu* is useful. (BS.urograha. 5)

20. Ring worm - Paste of *shigru* root-bark eradicates ringworm. (BS.kuştha. 66)

21. Coryza - Smoke of *śhigru* root mixed with ghee and oil should be taken. It alleviates coryza, cough and hiccough. (GN. 3.4.33)

22. Accidental wound - In accidental wounds, one should apply paste of *shigru* leaves and *tila* mixed with ghee. (VD.16.117)

23. Pox - *Sarjarasa* pounded with the juice of *shigru* leaves should be applied locally.(VD 11.20).

Doses of root bark juice is 10-20 ml., Seeds powder is 1-3gm.

Part used is root bark, seeds.

Specific formulations are *Shobhanjanadi lepa, Shyamadi churna.*

Moringa oleifera in Folk Medicine

Almost all the parts of this plant have been used for various ailments in the folk medicine of South Asia, including the treatment of inflammation, infectious diseases and cardiovascular, gastrointestinal, hematological and hepatorenal disorders.[21] It is used in folk medicine all over the world. Different parts and preparations of this plant have been reported to be used in ethnomedicine for treatment of various diseases.[22] The leaves were used in traditional remedies for tumors[23], extensively used as a natural sleep aid, applied as a poultice to sores, rubbed on forehead for headaches, and as a purgative cleanser.[24] It is an effective remedy for malnutrition, especially among infants and nursing mothers. Village women of southwestern Senegal were trained in the preparation and use of *Moringa* leaf powder in foods for development of growth and improving overall health in children, to cure anaemia in pregnant women and promote growth of foetus, as galactogouge.[25] In Uganda, leaves are used for

treatment of twenty four medical conditions such as diabetes mellitus, malaria/fever, hypertension, syphilis and skin disease.[26] Leaves extract is consumed to treat diarrhoea and teeth are washed with root decoction as remedy for toothache by people in Nhema, Zimbabwe.[27] Leaves extract drunk in Digestive disorders and HIV positive patients in Zimbabwe and considered to boost immunity.[28] The leaf of *M.oleifera* Lam. are is used for treatment of diabetes in Bangladesh.[29] *Moringa* oil has tremendous cosmetic value and is used in body and hair care as a moisturizer and skin conditioner. *Moringa* oil has been used in skin preparations and ointments since Egyptian times.[30]

Validation of Classical Therapeutic Potential using Reverse Pharmacology

Antiinflammatory activity: *Shigru* has been indicated in the treatment of oedema by Acharya Charaka (CS.Su.1.117). Its anti-inflammatory potential has been accepted by almost all classical texts. In animal studies, 95% ethanolic extract of seeds at 200 and 400 mg/kg orally, aqueous and ethanolic extract of root and root bark at 6 mg/kg orally, aqueous and ethanolic extract of leaves at 200 mg/kg orally reduced the caragenan induced paw edema in rats and mice dose dependently. Anti-infammatory activity in pharmacological studies validates classical claim.[31-32]

Hypoglycaemic/Antihyperglycaemic activity: *Moringa oleiphera* has been said to pacify *Vaat* and *Kapha* in Ayurvedic classical texts. Diabetes mellitus has been considered a disease caused due to vitiation of *Vaat Dosha*. Anti-diabetic potential of various parts of plant has been demonstrated in animal pharmacology. 80% ethanolic extract of the aerial parts (200 mg/kg, orally for 21 days) reduced the fasting blod glucose level of alloxan-induced diabetic male Wistar albino rats. Methanolic extract of the fruits (150 and 300 mg/kg, orally for 21 days) reduced the serum glucose and nitric oxide levels of STZ-induced diabetic Wistar albino rats. It also incrcased serum insulin, protein, pancreatic GSH(glutathione) and protein levels and activity of SOD and CAT while reduced the panereatic lipid peroxidation. Histopathological studies revealed that treatment with the extract inhibited the STZ-induced degeneration of panereatic β-cells in a dose-dependent manner on oral administration.[33-34]

Antiarthritic *M. oleiphera* has been considered as a potent analgesic, anti-inflammatory, hypolipidaemic and weight reducing drug. Pre-clinical studies have authenticated claims described in texts of Ayurveda. Administration of the 95 per cent ethanolic extracts of the seeds kernels and hydroalcoholic extract of the flowers 200 mg/kg, orally for 21 days showed antiarthritic activity against complete Freund's adjuvant- induced arthritis in albino rats by

reducing the body weight, paw oedema volume, inflammation at non-injected sites and arthritic index in a dose-dependent manner. Both the extracts also brought the erythrocytic sedimentation rate rheumatoid factor (RF), TNF-a and IL-1 levels. Further, the histopathological study revealed protective effect of extracts against bone destruction, cartilage erosion, angiogenesis and infilteration of lymphocytic cells. Their activity dexamethasone (2.5 and 5 mg/kg) at 100 and (ESR) to normal level and reduced the serum comparable with the standard drug, was The aqueous and alcoholic extracts of the root at 200 mg/kg, orally showed antiarthritic activity in complete Freund's adjuvant-induced arthritic male Wistar albino rats.[35]

Anticancer: It has been considered to be *Gulmahara* (Destroying the lump), *vidradhihara* (destroying abscess), pacifies *Apaci* (Chronic lymphadenitis). Classical texts of Ayurveda have indicated towards its anti-tumor potential. The aqueous, methanol, ethanol, ethyl acetate and chloroform extracts of the leaves (0.512- 200 ug/ml) showed concentration-dependent in vitro cytotoxicity against human multiple myeloma cell line. The methanol extract showed maximum activity with ID value being 0.32 ug/ml. The 50, 75 and 100 per cent methanolic extracts of the leaves were tested at 500 and 1000 mg/kg, orally for antitumour activity by administering them for 15 days to B16F10 melanoma bearing C57BL mice. The 75 per cent methanolic extract at 500 mg/kg dose and 100 per cent methanolic extract at both the tested doses, increased the survival time of mice as compared to the control group. The 100 per cent methanolic extract at 1000 mg/kg dose showed most pronounced effect.[36-37]

Immunomodulatory: Classical texts of Ayureda have considered *M. oleiphera* to increase digestive power and improve capacity of body to fight against various diseases (K.Ni.).[38] in some parts of country, fruits and leaves are used as vegetable and considered to enhance immunity. The 95 per cent ethanolic extract of the seeds (50, 100 and 200 mg/kg, orally for 7 days) showed immunosuppressive activity in Swiss albino mice by inhibiting both the non specific and specific immunity. It decreased the total lymphocyte count, spleen weight and number of splenic lymphocytes as compared to the control group. It decreased the delayed-type hypersensitivity reaction and humoral antibody response to SRBC. It also decreased the phagocytic index of macrophages as evidenced by carbon clearance test. However these effects of the extract were lower than those of the standard drug, dexamethasone. (0.27 mg/kg).[39]

Bronchodilator/Antiasthmatic: Soup of the leaves of *M. oleiphera* with some other drugs has been indicated to alleviate hiccough and asthma. (CS.Ci.17.99) Soup of *shigru* fruits with *marica*, salt and *yavakşara* checks hiccough and asthma, (CS.Ci. 17.98). Smoke of *śhigru* root mixed with ghee and oil should be taken. It alleviates coryza, cough and hiccough (GN. 3.4.33). Classical claims have been authenticated in animal studies. The 95 per cent ethanolic extract of the seed kernels at 100 and 200 mg/kg, orally showed bronchodilator activity in guinea pigs by inhibiting the histamine and acetylcholine aerosol-induced bronchospasm. At higher tested dose, it increased the preconvulsion time by 56.31 and 36.13 per cent in acetylcholine and histamine models, respectively. Further at 0.5, 1.0 and 2.0 ug/ml concentrations, it inhibited the compound 48/80 and egg albumin induced in vitro degranulation of rat peritoneal mast cells. At 2.0 pg/ml concentration, it produced 68.82 and 72.58 per cent inhibition, respectively. Its bronchodilatory and mast cell stabilizing activities were comparable with the standard drug, ketotifen fumarate (1 mg/kg and 10 ug/ml, respectively).[40]

Antiulcer *Tikta* (bitter) drugs are reputed for pacification of *Pitta dosha* which is responsible for ulceration. Leaves of *M. oleiphera* are bitter in taste and are used for pacification of acid peptic disease (CS.). Aqueous extract of the leaves at 300 mg/kg orally resulted in decrease in ulcer index and increase in the activities of SOD and CAT in aspirin-induced gastric mucosal damage test in rats. The extract however, also protected the mucosal basement membrane of stomach from gastric ulcers.[41]

Hepatoprotective *M. oleifera* is being used as *deepana* (Useful for stimulating digestive power). Its leaves are bitter in taste and bitterness is considered to be hepato-stimulent and cholagouge. The decoction of leaves of *M. oleifera* has been used in hemorrhoids as a sitz bath. The methanol extracts of the flowers and leaves at 250 mg/kg, orally and steroidal and coumarin fractions of the leaves at 150 mg/kg, orally showed protective activity against CCl_4,-induced hepatotoxicity in male Wistar albino rats as evidenced by reduced levels of SGPT, SGOT serum ALP, bilirubin and histopathological studies of liver of treated groups as compared to the control group. The coumarin fraction showed the highest activity. However, it was less active than the standard drug, silymarin (50 mg/kg).[42]

Cardioprotective: It has been considered to be Cardiotonic (Wholesome for heart). Pre-clinical studies have authenticated claims described in texts of Ayurveda. The lyophilized hydroalcoholic extract of the leaves administered at a dose of 200 mg/kg, orally for 30 days,

protected the male Wistar albino rats against isoproterenol-induced myocardial damage. It improved the heart rate, left ventricular end diastolic pressure and left ventricular peak positive and negative pressures. It also improved the myocardial endogenous antioxidant defense system by restoring the SOD, CAT, GPx enzyme activity. However, it had no effect on mean arterial pressure and myocardial GSH.[43]

Hypolipidaemic / Antihyperlipidaemic: *M. oleiphera* has been considered to be *Medohar* (anti-lipidaemic) by all the scholars of Ayurveda. Animal studies have proved its hypolipidaemic potential. Oral administration of the fruit powder at 200 mg/kg, orally for 120 days to normal and hypercholesterolaemic diet fed male rabbits reduced their body weight, total cholesterol, triglycerides, phospholipids, total lipids level in serum heart, aorta and liver as well as serum LDL, VLDL levels, lipid to protein ratio, cholesterol to atherogenic index while increased the HDL ratio as compared to respective control groups It also increased faecal excretion of cholesterol and total lipids in hypercholesterolaemic rabbits. However, it decreased the HDL level in normal rabbits. Its activity with the standard drug, lovastatin (6 mg/kg).[44]

Analgesic: *M. oleiphera* has been considered among best drugs pacifying *Vaat dosha* (one of the three humors considered responsible for pain and pleasure). Vitiation of *vaat* is the basic cause of all types of pain. Its analgesic potential has been established in animal studies. The 95 per cent alcoholic extract of the seeds at 30 mg/kg, orally, its petroleum ether fraction at 100 mg/kg, orally and ethyl acetate, diethyl ether and n-butanol fractions at 300 mg/kg orally showed analgesic activity in male Wistar albino rats in hot plate and tail immersion tests. The alcoholic extract showed most potent analgesic activity which was comparable with the standard drug, aspirin (25 mg/kg).[45]

Antipyretic: It has been indicated in the management of fever / common cold and other seasonal fevers (K.Ni).[46] The 95 per cent ethanolic extract of the seeds and its petroleum ether, diethyl ether and ethyl acetate fractions were tested at 300 mg/kg, orally for antipyretic activity against yeast induced pyrexia in male Wistar albino rats. The ethanolic extract and its ethyl acetate fraction showed the activity while other fractions were devoid of activity.[47]

CONCLUSION

M. oleiphera is an important drug described in classics of ayurveda and used very commonly in therapeutics. Various pharmacological studies have authenticated therapeutic potential of

the drug described in classics of Ayurveda and folk claims. It is an abundantly available plant drug having vast therapeutic potential. It fulfills all the requisites for an ideal drug described in Classics of Ayurveda. Its use in diet as well as drug has the potential to alleviate number of tough ailments. There is an urgent need to advocate its inclusion in diet as vegetable as well as dietary supplement among masses.

Abbreviations

CS. – Charak Samhita; SS.- Sushrut Samhita; AH.- Ashtanga Hridaya; VM.- Vrndamadhava; SB.- Siddhabhesajamanimala: HS.- Harita Samhita; SG.- Sarngadhara Samhita CD.- Chakradatta; BS.- Bangasena: GN.- Gadanigraha; VD.- Vaidhya Manorama KN.- Kaiyadeva Nighantu.

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