International Journal of PharmTech Research
CODEN (USA): IJPRIF, ISSN: 0974-4304
Vol.7, No.4, pp 566-572, 2014-2015

Murraya koenigii (curry leave)- A review on its potential.

Muthulinggam Nishan, Partiban Subramanian

[1]Department of Biomedical Science, Faculty of Biomedicine and Health, ASIA Metropolitan University, Malaysia
[2]Department of Biomedical Science, Faculty of Biomedicine and Health, ASIA Metropolitan University, G-8 JalanKemacahaya 11, Taman Kemacahaya, Batu 9, 43200 Cheras, Selangor, Malaysia

Abstract: "Medicine is food and food is medicine" is the best way to describe on 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. The carbazolealkaloids such as koenigin, bicyclomahanimbicine, cyclomahanimbine, murrayastine, coumarine, koenidine and pypayafolinecarbazole has substantial medicinal activities.
Keywords: *Murraya koenigii*, Pharmacological activity, Carbazolealkoloids.

Introduction

Murraya koenigii Spreng is called as 'Surabhinimba' in Sanskrit and belongs to the family of Rutaceae. Curry leaves is called by different name by the different ethnic, In Tamil we called as Karivempu, Bengali as 'Barsunga', in Hindi we called as Kurrypatte[1]. Among fourteen global species belongs to the genus of *Murraya*, only *Murraya koenigii* Spreng and *Murraya paniculata* (Linn) is available in India[1].*Murraya koenigii* which belong to the family of Rutaceae represents more than 150 genera and 1600 species. The leaves of this plant has been used widely in indian culinary and the chemical substance which responsible for its aromatic characteristic is P- gurjunene, P- caryophyllene, P- elemene and O- phellandrene[2]. The presence of β- pinene, β- caryophyllene, β- phellandrene and α- pinene has ability to control the food spoilage either alone or by combination[3]. The author states that the three different morphotypes of *Murraya koenigii* poses different intensity in its flavor. The regular type of *Murraya koenigii* is the fastest growing plant with good looking leaves and with dark green in color. The dwarf type grows as shrub and branches are spread and appears like bushy and the leaves are in light green in color with little taller like regular type and poses its own aroma. The brown type is the most fragrant one, with thick and smallest leaf structure and in dark brown in color[3].

Previous study has been done widely on curry leave from its stem up to its bark and, thus this review gathers variety of idea from multifarious research which has been done on curry leave and provides a better cognizance of its therapeutic and non-therapeutic properties.

Taxonomic Classification[5]
Kingdom-Plantae
Subkingdom- Tracheobionta
Superdivision- Spermatophyta
Division- Magnoliophyta
Class- Magnoliopsida
Subclass - Rosidae

Family- Rutaceae
Genus- *Murraya J. Koenig* ex L.
Species- *Murraya koenigii (L.)*Spreng.

Figure 1: Shows the whole plant of *Murraya koenigii* (A) leaves (B), Seeds (C)[4].

Traditional uses

The barks and roots are used externally to cure the bites of the poisonous animals; the green leaves were eaten raw as a cure for dysentery, diarrhea[2]. Infusion of roasted leaves were given in order to stop emesis[1].Furthermore, *Murraya koenigii*were also used as blood purifier, tonic and cure for stomachache and used as flavoring agents in curries and chutneys[6]. Curry leaves were also used as calcium source to those having calcium deficiency besides that it also consist Vitamin A, Vitamin B and B2, Vitamin C and iron. For the treatment of morning sickness; fresh juice of curry leaves together with lime juice and sugar is given and it is also applicable for vomiting due to indigestion. In the case of stomach upsets, the curry leaves is grounded to a fine paste and mixed with buttermilk and consumed orally. A paste of curry leaves is applied on the boils for swift relief, besides that, renal pain can be cured by consuming the root as a juice .The fresh juice of curry leaves can prevent the progression of cataract. *Murraya koenigii* will retain the black color of the hair or in other words, it will prevent the premature greying of the hair[7].

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[8].

Morphological characteristic

Murraya koenigii has small spreading shrub which about 2.5 meters in height, the stem is dark green to brownish in color. Upon peeling of the bark longitudinally the underneath white wood is visible. The main stem's diameter is about 16cm. The leaves are about 30 cm long with each bearing 24 leaflets and have a reticulate venation. The flower is white funnel- shaped, having a sweet aromatic characteristic and the average diameter of fully opened flower would be 1.12cm and it is bisexual. The fruits are round to oblong in shape with 1.4 to 1.6cm in length and 1 to 1.2cm in the diameter. The fruit upon fully ripe will be black in color together with a shining surface and the pulp will be in wisteria blue. The seed will be spinach green with 11mm long and weigh about 445mg[8,9].

Phytochemistry

The matured curry leaves consist 63.2% of moisture, protein which is of about 1.15% of nitrogen, carbohydrate 14.6% which is of total sugars and total ash 13.06%. The bioactive components in curry leaves are oxalic acid, resin, carbazole alkaloids and the major bioactive compounds such as the koenigin, bicyclomahanimbicine, cyclomahanimbine, murrayastine, coumarine, koenidine and pypayafolinecarbazole has signaficant pharmacological activities and the major portion of volatile oil consist of bicyclomahanimbicine, mahanimbicine[10].

The composition of volatile compounds found in the essential oil of *Murraya Koenigii* from the state of Sabah, Malaysia as follows; Linalol (0.56%), *trans*-Sabinene hydrate (0.53%), *trans*-2-Cyclohexen-1-ol (0.48%), *cis*-2-Cyclohexen-1-ol (0.54%), *para*-Cymen-8-ol (10.31%), *β*-Terpinol (2.52%), *trans*-Piperitol (0.40%), Chrysanthenyl acetate (0.39%), Lavandulyl acetate (1.67%), Bornyl acetate (1.68%), α-Copaene (0.82%),β- Elemene (0.35%), (Z)-Jasmone (0.11%),β-Caryophyllene (19.50%), Aromadendrene (0.72%), α-Humulene (15.24%), Butanedioic acid (2.18%), β-Selinene (3.81%), Naphthalene (1.90%), α-Selinene (6.10%),δ-Cadinene (2.03%), Nerolidol (2.64%), *trans*-Nerolidol (1.32%), Cycloheptane (0.13%),Spathulenol (1.98%), Caryophyllene oxide (2.14%), Viridiflorol (1.51%), 2-Naphthalenemethanol (0.66%), Trivertal (0.35%), Juniper camphor (1.57%), Cubenol (0.57%),β-Cadina-1(6),4-diene (0.50%), Selina-6-en-4-ol (4.78%), Phytol (10.07%)[11].

The roots of *Murraya koenigii* consist bioactive compounds which is named as murrayanol, murrayagetin, marmesin-1''-O-rutinoside. In addition to that three monomeric and five binary carbazole alkaloids namely mukoenine-A, B and C and murrastifoline-F.bis-2- hydroxy-3-methyl carbazole, bismahanine, bi koeniquinone-A and bismurrayaquinone-A were also extracted from the bark. The benzene extract of roots consist of mukoline, mukolidine. The root were also found to have girinimbine and the root bark consist of koenoline which synonym to 1-methoxy-3-hydroxy methyl carbazole[8].

The fruit of the *Murrayakoenigii* consist of mahanimbine and koenimbine upon extracted by petroleum ether. Furthermore, isomahanine and murrayanol were isolated together with mahanimbine, murrayazolidine, girinimbine, koenimbine and mahanine[4,8].

Seed of *Murraya koenigii* consist of 3 bioctivecarbazole alkaloids which iskurryam, koenimbine and koenine. Furthermore, the seed also contain mahanimbine, girinimbine, koenimbine, mahanine and isomahanine. An indicolactone, anisoalctone and 2',3'epoxyindicolactone which is a furocoumarin lactone were extracted from the seeds and this would be the first furocoumarin with a mono terpenoid lactone chain found in the genus of the *Murraya* and minor furocoumarins were also found in the seeds of *Murraya koenigii* such as xanthotoxin, isobyaknagelicol, byakangelicol and isogosferol. isoheraclenin, isoimperatonin, oxypeucedanin, isopimpinellin and bergaptan were also found in the seeds of *Murrayakoenigii*[4,8].

Leaf of *Murrayakoenigii* consist of koenimbine, O-methyl murrayamine, O- methyl mahanine, isomahanine, bismahanine and bispyrayafoline, koenigine, koenine, koenidine, mahanimbine, isomahanimbine, koenimbidine and murrayacine, isomahanimbicine, Euchrestine B, bismurrayafoline E, mahanimbicine, bicyclomahanimbicine, cyclomahanimbine, bicyclomahanimbine, mahanimbidine, mukonicine, 8,8''-bis koenigine which consist monomer of koenigine and minor alkaloid; mahanine. The dried leave consist of glycozoline, 1-formyl-3 methoxy-6-methyl carbazole and 6, 7- dimethoxy-1- hydroxy-3 methyl carbazole. The leaves of *Murraya koenigii* also consist of protein, carbohydrates, fibre, minerals, carotene, vitamin C, Nicotinicacid[4,8].

The chemical structure below (Figure 2) shows the compounds that was isolated from the bark of Malayan *Murraya koenigii* by using hexane and dichloromethane and isolated via various chromatographic techniques and the structural characterization of the isolated compounds were supported by spectroscopic methods including Nuclear Magnetic Resonance, Infrared, Ultraviolet, Mass spectra data[12].

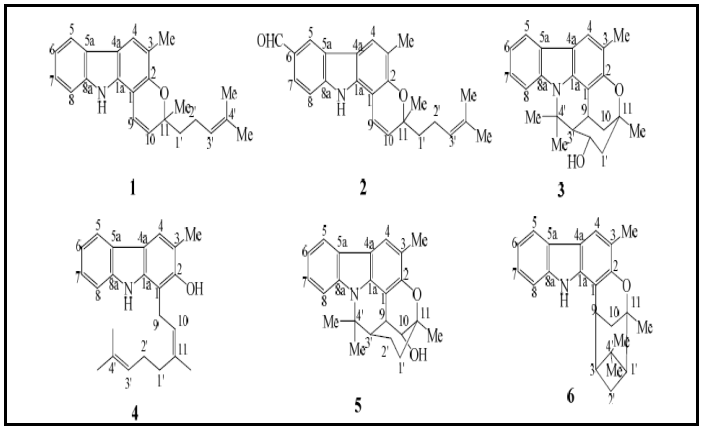

Figure 2. Shows the chemical structure isolated from the bark of *Murraya koenigii*[12].

The chemical structure number 1 shows Mahanimbine ($C_{23}H_{25}NO$) followed by number 2;Murrayamine-J($C_{23}H_{23}NO_2$), number 3; Murrayazolinol ($C_{23}H_{25}NO_2$), 4; Mahanimbinol ($C_{23}H_{27}NO$), 5; Murrayakoeninol ($C_{23}H_{25}NO_2$) and number 6 figure shows; Bicyclomahanimbine ($C_{23}H_{25}NO$).

Microscopy and Macroscopy studies

The macroscopical view of the leaves of *Murraya koenigii* L. Spreng is obliquely ovate or fairly rhomboid with acuminate obtuse or acute apex. The petiole is about 20 to 30 cm in length and the leaves have reticulate venation and dentate margin with an asymmetrical base. In the microscopic studies, it was elucidate that the stomata were distributed on abaxial surface and the adaxial surface does not have stomata and the type of stomata that was found is anomocytic. The transverse section of the leaves has a layer of epidermis which is composed of rectangular cell which serves as an outermost covering for both upper and lower layer. Furthermore, the author also stated that the upper epidermis was covered with deposition of cuticle, and in the midrib part or portion the epidermis has 1 to 4 layers of collenchymatous hypodermis with 2-5 layers of chlorenchyma cells which is filled with cholorophyll contents. The ground tissue consists of oval to polygonal parenchyma cell and is slanted with vascular bundle. Calcium oxalate can be found in this region which is in the form of sandy and prismatic crystals[13].

Pharmacological activity of *Murraya koenigii*

Antimicrobial activity

The hexane, methanol and chloroform extract of the *Murraya koenigii* root were tested against *Bacillus subtilis, Staphylococcus aureus, Escherichia coli*, *Salmonella typhi* and fungal strain of *Aspergillus niger*, *Candida albicans* and *Trichophyton rubrum*. The hexane, methanol and chloroform extract of the root of *Murraya koenigii* was effective on all the tested strains and methanol extract showed more significant antimicrobial activity compared to the others with maximum inhibitory effect on *Staphylococcus aureus* and *Trichophyton rubrum*. The *Staphylococcus aureus* were susceptible to the all the three extracts above, furthermore the aqueous extract of the root were found to be ineffective against the tested microorganism[14].

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 *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[15].

Hypoglycemic effects

The plasma glucose levels were found to be decrease in the alloxon induced rats on treatment with aqueous and methanolic extract of *Murrayakoenigii*leaves[16]. The ethanolic extract of *Murraya koenigii* stem shows remarkable reduction in the blood glucose level, total cholesterol level, triglyceride and body weight[17].Mahanimbine which is a carbazole alkaloid obtained from *Murraya koenigii* leaves shows antihyperglycemic and hypolipedimic 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[18].

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 spraguedawley 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[19].

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 serve as positive control. Besides that, the serum bilirubin has no major reduction in its level upon administration of both doses of the extract[20].

Anti-inflammatory

The leaves of *Murraya koenigii* was subjected to extraction with three various solvents; petroleum ether, chloroform and ethanol. A dose of 250mg/kg was selected which is a $1/10^{th}$ of 2500mg/kg which was considered as LD_{50}, 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[21].

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[22].

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 suggest that the cell death induced by the girinimbine can be via classical mitochondrial pathway with cytochrome C release and caspase dependent apoptosis[23]. 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[24].

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[25].

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[26].

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[27]. 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[28].

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 *Murrayakoenigii*[29].

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[30]

Other uses

Mosquitocidal activity

Petroleum ether extract and the acetone extracts of *Murraya koenigii* leaves serves as larvacide for *Aedes aegypti* at the concentration range from 250ppm -900ppm[31].

Conclusion

Murraya koenigii was one of the medically beneficial plant which has been used many century ago by our ancestors. In the current globalization era, it is difficult to find a curry plant in majority of the houses and many diets has been dependent to synthetic agent as taste enhancer against curry leaves. Thus, the importance of these beneficial plant should be emphasized and the bioactive components of *Murraya koenigii* should be analyzed further and used against the disease that have been developed resistance and synergistic studies should be carried out.

Acknowledgement

I would like to extent my gratitude to my beloved mother, Mahaswary D/O Govindasamy for her continue Love, Support, Blessings and Prayers, DR. Partiban Subramanian who is my research guide, who continuously supported me and serve as the backbone for me to complete this review paper. Sivananthan anoharan who continuously encourage me for betterment especially for my milestone stepping paper: Pharmacology and non-pharmacology activity of *Azadirachta indica* (Neem) - A review, and finally to the almighty god (Ellam Pugalam Iraivanke).

References

1. Nayak A, Mandal S, Banerji A, Banerji J., Review on chemistry and pharmacology of Murraya koenigii Spreng (Rutaceae), Journal of Chemical and Pharmaceutical Research., 2010, 2(2), 286-299.
2. Saini S.C, Reddy G.B.S., Murraya koenigii, Journal of Pharmacy and Biological Sciences., 2013, 7(6), 15-18.
3. Sivakumar C.H.V, Meera I., Antioxidant and biological activities of three morphotypes of Murraya koenigii L. from uttarakhand, Journal of Food Process and Technology., 2013, 4(7), 1-7.
4. Gahlawat D.K, Jakhar S, Dahiya P., Murraya koenigii (L.) Spreng: An ethnobotanical, phytochemical and pharmacological review,Journal of Pharmacognosy and Phytochemistry., 2014, 3(3), 109-119.
5. Kumar S.R, Loveleena D, Godwin S., Medicinal property of Murraya koenigii- a review, International Research Journal of Biological Sciences., 2013, 2(9), 80-83.
6. Sindhu R.K, Arora S., Evaluation of phenolic contents and antioxidant potential of Murraya koenigii (L) spreng roots, Journal of Applied Pharmaceutical Science., 2012, 2(11), 120-122.
7. Parul S, Javed A, Neha B, Honey J, Anuj B., Curry leaves- A medicinal herb, Asian Journal of Pharmaceutical Research., 2012, 2(2), 51-53.
8. Jain V, Momin M, Laddha K., Murraya Koenigii: An Updated Review, International Journal of Ayurvedic and Herbal Medicine., 2012, 2(4), 607-627.
9. Singh S, More PK, Mohan SM., Curry leaves (Murraya koenigii Linn. Sprengal)-a mircale plant, Indian Journal of Scientific Research., 2014, 4(1), 46-52.
10. Ganesan P, Phaiphan A, Murugan Y, Baharin B.S., Comparative study of bioactive compounds in curry and coriander leaves: An update, Journal of Chemical and Pharmaceutical Research., 2013, 5(11), 590-594.
11. Nagappan T, Ramasamy P, Abdul Wahid M.E, Segaran T.C, Vairappan C.S., Biological activity of carbazole alkaloids and essential oil of Murraya koenigii against antibiotic resistant microbes and cancer cell lines, Molecules., 2011, 16, 9651-9664. http://dx.doi.org/10.3390/molecules16119651.
12. Tan S.P, Nafiah M.A, Ahmad K., C23- carbazole alkaloids from Malayan Murraya koenigii (L.) spreng. Journal of Chemical and Pharmaceutical Research., 2014, 6(4), 1093-1098.

13. Handral H.K, Jha P.K, Shruthi S.D., Pharmacognostic and phytochemical studies on the leaves of Murraya koenigii (L) Spreng, Pharmacophore., 2010, 1(3), 231-238.
14. Malwal M, Sarin R., Antimicrobial efficacy of Murraya koenigii (Linn.)Spreng.root extracts, Indian Journal of Natural Products and Resources., 2011, 2(1), 48-51.
15. Rageeb M.D, Usman M.D, Barhate S.D., Phytochemical evaluation and effect of antipyretic activity on Murraya koenigii Spreng. Leaves extract, International Journal of Pharmaceutical and Chemical Sciences., 2012, 1(1), 231-236.
16. Vinuthan M.K, Kumar G.V, Ravindra J.P, Jayaprakash, Narayana K., Effects of extracts of Murraya koenigii leaves on the levels of blood glucose and plasma insulin in alloxan induced diabetic rats, Indian Journal of Physiology and Pharmacology., 2004, 48(3), 348-352.
17. Prabhu K.A, Tamilanban T., Investigation of antidiabetic activity of stem of Murraya koenigii, International Journal of Research in Pharmacology and Pharmacotherapeutics.,2012, 1(2), 165-168.
18. Dineshkumar B, Mitra A, Mahadevappa M., Antidiabetic and hypolipidemic effects of mahanimbine (carbazole alkaloid) from Murraya koenigii (rutaceae) leaves, International Journal of Phytomedicine., 2010, 2, 22-30.
19. Parimi B.N, Mopuri R, Meriga B., The protective effect of Murraya koenigii leaves against carbon tetrachloride- induced hepatic damage in rats, Journal of Costal Life Medicine., 2014, 2(4), 313-318. http://dx.doi.org/10.12980/JCLM.2.201414J9.
20. Sathaye S, Amin P.D, Mehta V.B, Zala V.B, Kulkarni R.D, Kaur H, Redkar R., Hepatoprotective activity of Murraya koenigii against ethanol induced liver toxicity model in experimental animals, International Journal of Pharma and Bio Sciences., 2012, 3(1), 430-438.
21. Darvekar V.M, Patil V.R, Choudhari AB., Anti-inflammatory activity of Murraya koeniggi Spreng on experimental animals, Journal of Natural Product and Plant Resourse., 2011, 1(1), 65-69.
22. Prasad G.B.K.S, Dua V.K., Anti-inflammatory activity of leaves extract of Murraya koenigii L. International Journal of Pharma and Bio Sciences., 2011, 2(1), 541-544.
23. Mohan S, Abdelwahab S.I, Cheah S.C, Sukari M.A, Syam S, Shamsuddin N, Mustafa M.R., Apoptosis effect of girinimbine isolated from Murraya koenigii on lung cancer cells in vitro, Evidence- Based Complementary and Alternative Medicine 2013., 2013, 1-12. http://dx.doi.org/10.1155/2013/689865.
24. Handral H.K, Pandith A, Shruthi S.D., A review on Murraya koenigii: Multipotential medicinal plant, Asian Journal of Pharmaceutical and Clinical Research., 2012, 5(4), 5-14.
25. Tembhurne S.V, Sakarkar D.M., Anti- obesity and hypoglycemic effect of ethanolic extract of Murraya koenigii (L) leaves in high fatty diet rats, Asian Pacific Journal of Tropical Disease., 2012, 2(1), 166-168.
26. Swati D, Pathak A, Burande M.D., Antigenotoxic effect of Murraya koenigii towards cyclophosphamide induced cytogenetic damage in mouse bone marrow cells, International Journal of Pharmacognosy and Phytochemical Research.,2012, 4(2), 59-63.
27. Sharma U.S, Sharma U.K, Singh A, Sutar N, Singh P.J., In vitro antihelminth activity of Murraya koenigii Linn.Leaves extracts, International Journal of Pharma and Bio Science., 2010, 1(3), 1-4.
28. Kumar A, Tripathi A, Dora J, Tripathi R., Antihelmintic activity of methanolic extract of Murraya koenigii leaves (Linn), International Journal of Research in Pharmaceutical and Biomedical Sciences., 2011, 2(4), 1698-1700.
29. Shah K.J, Juvekar A.R., Positive inotropic effect of Murraya koenigii (Linn.) spreng extract on an isolated perfused frog heart, Indian Journal of Experimental Biology., 2006, 44(6), 481-484.
30. Bhandri P.R., Curry leaf (Murraya koenigii) or cure leaf: Review of its curative properties , Journal of Medical Nutrition and Nutraceuticals., 2012, 1(2), 92-97.
31. Ajay S, Rahul S, Sumit G, Paras M, Mishra A, Gaurav A., Comprehensive review: Murraya koenigii Linn, Asian Journal of Pharmacy and Life Sciences., 2011, 1(4), 417-425.

*****