SIGNIFICANCE OF *Murrayakoenigii* and *Asparagus racemosus*AND THEIR COMBINED EFFECTS- A REVIEW

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ABSTRACT: *Despite scientific progressions and globalization the system of traditional medicine and alternative medicine is considered as a chief health care resource in the resource-constrained health care setting. Traditional plants act as the major source of medicine since the ancestral times. These plants have valuable phytochemical compositions contributing towards therapeutic potential for maintaining human health. Till date herbal treatments are sought after for curing various ailments. In India, medicinal plants are traditionally rooted as can be seen from Siddha treatments and Ayurvedic treatments which are heavily sought after by many individuals. Previously, much light was not shed on traditional medicinal plants and the eyes were closed to its phytotherapy properties and application. Presently renaissance and renewed interest on traditional medicinal plants have been observed among the public and scientific community. Furthermore, medicinal plants ease of accessibility and renewable properties makes these plants as the best source for obtaining a variety of drugs. The plants Murrayakoenigii and Asparagus racemosus which are consumed on a daily basis as food source possess vital medicinal values like antibacterial, antifungal, anti-inflammatory, etc. These properties serve as a potential solution towards modern diseases and health related concerns.*

Key Words: *Traditional medicine, phytochemical, therapeutic, phytotherapy*

1.Introduction

The current modern world is not only advancing technologically but also medicinally bringing along new and dominant diseases that persists to exist despite modern medicine effects. As humans evolve new diseases are evolving along with them. This is the result of changes in environment, food habits and individuals interest in maintaining health. The current norm is to go green, as many people start turning towards naturally available medications rather than modern medicine. Till date plants are the primary resource for drug development this is due to the detrimental effects these modern medicines have on human health and the side effects that are possible to arise from their consumption. The usage of such natural medicines has existed since mankind came into existence. Traditionally available plants have been used for treating injuries and diseases over thousands of years since the time life came into existence backed by evidences from Unani Hakims, Ayurvedic texts and European and Mediterranean cultures. Till date, traditional plants are used for medicinal treatments in rural areas for they are easily, abundantly and readily available source prescribes as medicine in such rural areas. These plant resources are safer, vastly available, causes no side effects and renewable source that persists to exist despite harsh environments and natural calamities. Plants are continuously being researched by scholar and scientists who often confront difficulties due to paucity of authentic information on the identity, habitat, and condition of collection and use of medicinal plants.

The drugs started in traditional medicinal texts are specific for some particular disease or other proven to be effect on indigenous people. However, due to the lack of evidence people fail to recognise its medicinal significance. Moreover, the need for land and food has ceased some of these plants existence driving them towards the verge of extinction. New technologies and methods are present in the modern world to prevent extinction of plant species such as international seed banks, synthetic seed cultivation, green house plantation, plant sanctuaries, etc. These methods store extinct plant seed or parts of the plant such as its roots, leaves and flower. Till date, plants serve as the primary source for many modern medicines such as Morphine drug used in treating analgesic is derived from the plant *Papaver somniferunm*(Poppy) [13]. Nowadays, great amount of interest is being shown for herbal drug synthesis for traditional medicines have caused a surge in the scientific study of medicinal plants.

2.Importance of folklore medicinal plants

Folklore medicine is based upon theories, beliefs and experiences native to different cultures. Folklore medicine exists amongst different traditional societies as part of their culture to ensure the safety and

health of their communities. The disease related information and treatment is passed down from generations verbally or in the form of texts. Popularly known folklore medicine are Ayurveda, Siddha, Unani, Iranian medicine, Islamic medicine, traditional Chinese medicine, traditional Korean medicine, acupuncture and traditional African medicine.

These medicines serve as a home remedy shown to be effective for treating certain ailments. For example, the consumption of live-culture yogurt reduces vaginal yeast infection [7].Urban and rural poor people in India rely on herbal remedies since these are within their reach. This medicine has pushed World Health Organization to compile a record of medicinal plants noteworthy. Through folklore medicines observation and validation of the potential traditional medicines can be employed in primary health care [35].

2.1 Combinational plants benefits

The most prevalent ancient herbal traditional practice is Chinese herbalism. It's based upon the concept of yin and yang and Qi energy. The herbs containing "cooling" (yin) or "stimulating" (yang) properties are frequently used in combination [46].Research shows the Kampo medicine Juzen-taiho-to, a combination effect of multi-herbs, is a Chinese medicine that stimulates the immune function of Peyer's patch cells. Combined decoction of six herbs plays a crucial role for expressing activity of Peyer's patch cells [15]. These studies prove efficacy of combination of plant extracts towards treating diseases. Many medicinal plants are vastly available and are consumed as food on a regular basis. These plants can be grown in by individuals due to their excessive use. Plants of such nature taken into consideration are *Murrayakoenigii*and *Asparagus racemosus.*

3.*Murrayakoenigii*

*Murrayakoenigii*commonly known as curry leaves which acts as a significant ingredient in Indian cuisine promotes appetite and digestion. This plant is present in India, Sri Lanka and other south Asian countries. It is aromatic in nature possessing a strong atypical smell, its bark is grey and white in colour with leaflets having smooth margin on its leaflets known as bipinnate.

3.1 Applications of *Murrayakoenigii*

Traditionally, *Murrayakoenigii*leaves are traditionally used as a medicine for treating various ailments.

3.1.1 Antibacterial activity

Antibacterial is commonly used to destroy the bacteria which cause bacterial infection to host.The first anti-bacterial agent was synthesized by Ehrlich in 1910. M.koenigii shows 80-95% of antibacterial activity against S.aureus. Rajendran MP *et al* and Nagappan T *et al* found Essential oil extracts of *M. koenigii*has antibacterial properties against *S.aureus*bacteria[23,33]. Ningappa MB *et al* consumed Monomeric protein isolated from *M. koenigii*showed potent antibacterial activity against human pathogenic strains *Escherichia coli, Staphylococcus aureus, Vibrio cholerae, Klebsiella pneumonia, Salmonella typhi*and *Bacillus subtilis.* This monomeric protein is called antioxidant protein[24]. Gowtham M.P *et al* suggested *Essential* oil from *M. Koenigii* leaves showed effect against *B. subtilis, S. aureus, C. pyogenes, P. vulgaris and Pasteurellamulticida*. This pure oil was active against the bacteria even at a high concentration of 1:500 [8]. Narasimhan N.S *et al* found Acetone extracts of *M. koenigii* gives bioactive carbazole alkaloids mahanimbine, murrayanol and mahanine that showed mosquitocidal, antimicrobial and topoisomerase I and II inhibition activities [25].

3.1.2 Antifungal activity

Antifungal is used to treat the fungal infections which reduce the growth of disease causing fungi in host.The first antifungal amphotericin B deoxycholate was introduced in 1958. M.koenigii shows 80-85% of antifungal activity. Mishra M.K *et al* suggested *M. koenigii*acetone extract is active against *Aspergillus niger*, benzene extract is active against *Alternariasolani*and *Helminthosporiumsolani*and ethanol extract is active against *Penicilliumnotatum*[22]. Kumar NS *et al* predictedMahanimbine isolated from petroleum ether extract of the leaves of *M. koenigii* inhibited acetylcholinesterase [16].Patidar K *et* al identified Shampoo prepared from a combination of herbs including curry leaves showed quality and safe shampoo usage. These extract were tested against fungus *Malassezia* through disc diffusion method showed good cleansing and detergency property [27].

3.1.3 Antioxidant activity

Anti oxidants is a compound which inhibits the oxidation and damages the cells of the organisms. *M.koenigii* shows 70-80% of antioxidant activity. Tachibana Y *et al* identifiedAntioxidant activity of *M.koenigii*was done using different solvents. They were evaluated based on oil stability index together with their radical scavenging ability against 1-1-diphenyl-2-picrylhydrazyl (DPPH) [41]. Poh KH *et al* suggested*M.koenigii* leaves extract were analysed for antioxidant activity by 2, 2-diphenyl-2-picryl hydrazyl (DPPH) radical scavenging assay. It gave a 95.90% of inhibition proving its antioxidant capability [32]. Tachibana Y *et al*

found that the *M. koenigii*leaves contain mahanimbine, Bismurrayafoline E, Euchrestine, Bismahanine, Carotene and O-methyl mahanine that have antioxidant activity [41].

3.1.4 Anti-inflammatory activity

Anti inflammation is normally used to reduce the inflammation,swelling,feveretc.Inflammation is the first response to infection. *M.koenigii* shows 60-80% of anti-inflammatory activity. Parmar S *et al* found that, the alcohol extract of root, stem bark is effective against carrageenan-induced inflammation. Crude root extracts showed anti-inflammatory property as well. It was due to mast cell stabilization and anti-histamic effect of the ethanolic leaf extract contributing to anti-inflammatory property[28]. Prasad GB *et al* suggestedthat, themethanolic leaf extracts showed significant reduction in carrageenan-induced paw edemawhen compared to aqueous and hexane extract [29]. Gupta S *et al* identified thatthe methanolic extract showed significant (P<0.001) reduction in carrageenan induced paw edema and analgesic activity by increasing the reaction time by Eddy's hot plate method and percentage increase test in formalin test [9].

3.1.5 Anti-cancer activity

Anti cancer plays an important role of reduces the multiplications of tumour cells.*M.koenigii* shows 30-45% of anti-cancer activity.Antioxidant parameters of reduced glutathione, SuperOxide dismutase, catalases, glutathione peroxidase and glutathione reductase were elevated [17]. Kok YY *et al* foundStudies on in-vitro anti-tumor promoting activity and antioxidant property of Girinimbine isolated from the stem bark of *M. koenigii* were done. The in-vitro anti-tumour promoting activity of girinimbine was determined by measuring the percentage inhibition of induced early antigen of EBV on the surface of the cells [18]. Roy MK *et al* research shows that mahanine down-regulates cell survival factors by activation caspases-3 through mitochondrial dependant pathway and by disrupting cell-division. This is found to induce apoptosis in human myeloid cancer cell (HL-60) [34].

3.2 Other applications

The leaves, bark and roots are tonic, carminative and stomachic. Curry leaves are used in dysentery and to rectify vomiting sensation, to cure skin eruption and skin burns the leaves are crushed into a paste. Ayurvedic medicine system dries the *Murrayakoenigii*leaves mixing it with honey and betel nut juice as an anti-periodic cure. Scientifically, various researches on various parts of *M. koenigii*have been analyzed for its pharmacological activities using ethanol, petroleum ether, chloroform, methanol, alcoholic and aqueous extract [36,49].

4.*Asparagusracemosus*

Asparagus racemosus, commonly known as Rasayana herb in Ayurvedic texts, has adaptogen which boosts the immune system to resist a wide range of foreign invading organisms. *A.racemosus*belongs to the family of lilies and is valued for its therapeutic properties. It is largely used as traditional medicine in Bangladesh. This is found in India, Sri Lanka, Himalayas and Nepal predominantly amongst the Asian continent.

4.1 Applications of *Asparagus racemosus*

*A.racemosus*treats various disorders such as tumors, inflammation, cardiac related problems, bronchitis and many other infectious diseases.Asparagus contains 93% of water as a main constituent. Various parts of *A.racemosus*are used for medicinal treatments.

4.1.1 Antibacterial activity

Antibacterial is used to destroy the growth of disease causing bacteria.The first anti bacterial was introduced in 1910 by Ehrlich.A.racemosus shows 80-95% of antibacterial activity against *S.aureus*. Venkatesan N *et al* found that theRoots and leaves of *asparagus racemosus* acts against scurvy which is commonly known as hitching [45].Bopana N *et al* found that the leaf extracts of *A.racemosus* has anti-bacterial properties against many bacteria like *S.aureus,Escherichia coli,Shigellaflexneri,Shigelladysentriae,Shigellasonnei,Vibrio cholerae,Salmonella typhimurium,Pseudomonas putida,Salmonella typhi*and *Bacillus subtilis* which is normally associated with respiratory infection[4,30, 38].

4.1.2 Anti-inflammatory activity

Anti inflammatory is normally used to reduce the inflammation,swelling,fever etc.Inflammation is the first response to infection.*A.racemosus* shows 80-85% of anti-inflammatory activity.Goel RK *et* al found that the leaf extracts of A.racemosus gave positive result in anti-inflammatory which combined with ethanol used to reduce the swelling and shows the presence of flavonoid and sterol compounds [11].Wiboonpun N *et al* statedthe root extracts of A.racemosus shows good result in anti-inflammatory activity in monocyticleukemia cell line THP-1.root extract was combined with ethanol which shows anti-inflammatory activity on carragenin and serotonin [47].

4.1.3 Anti-cancer activity

Anticancer plays an important role in reducing the multiplication process of tumor cells.*A.racemosus* shows 50-65% of anti-cancer activity.Goel RK *et al* found thatthe root extracts of *A.racemosus* shows positive result in anti-cancer activity through the combination of chloroform: ethyl acetate in a ratio of 2:1 which resulted in rich factor anti-cancer activity in both in-vitro and in-vivo method [2,11] .Suchita M *et al* statedleaf extraction of *A.racemosus* shows the positive result in anti-tumor activity which combined with chloroform shows the presence of phytochemicals like alkaloid, tannin, glycoside, flavonoid, terpenoid and steroid[40].

4.2 Other applications

Trace elements present in it enhances the ability of glucose transport from the bloodstream into the cells [19]. It helps to restore female related problems such as menopause, irregular menstrual cycle and menstrual cramps [43].*A.racemosus*has many biological properties such as an Antioxidant, Immunostimulant, Immunomodulatory, Anti-hepatotoxic, Antibacterial,Anti-cytosic, and also acts as thereproductive agent [19]. Asparagus acts as a good source for vitamin B6, calcium, magnesium and zinc and also good source in dietary fiber, protein, beta-carotene, vitamin E, vitamin C, vitamin K, thiamin, riboflavin, rutin, niacin, folic acid, ion and zinc [14]. Uterine tonic synthesized from *A.racemosus*helps to improve breast milk secretion; this drug is called as galactogogue and best general health tonic [3,19,30-31].Moreover, its useful in cancer treatment, diabetes, hangover, rheumatism, tuberculosis, depression, neurodegenerative diseases, premenstrual syndrome and bone health [3]**.**It also has positive impact on the respiratory system helping to eradicate harmful and toxic substances accumulating within the lungs and affects the transmission of nerve impulses in Central Nervous System [19].

5. Combined activities of *Murrayakoenigii*and *Asparagus racemosus*

Comparative studies have been done for *Murrayakoenigii*with other medicinal plants such as mint leaves, *Olea europaea, Moringaoleifera, Hibiscus sabdarrifa*and *Centellaasiatica.* However, the *M.koenigii*leaves have not been combined with the plants and evaluated for a combinational activity from the mixture of plant species.

A comparative study has been done for *Asparagus racemosus*in comparison to three plant species of *Hageniaabyssinica, Fuerstaafricana* and *Ekebergiacapensissparrm* for their antimicrobial property and toxicity. However, the *A.racemosus*have not been combined with the plants and evaluated for a combinational activity from the mixture of species.

*M.koenigii*leaves have *notable* pharmacological activities but past studies have elucidated the plant studies with *A.racemosus*. No studies have been done on the combination of plants and the different phytochemical constitution.

Comparative studies have been done for *A.racemosus*fresh and dry roots, but past studies have elucidated its studies with *M. koenigii.*A combinational study on *M.koenigii*and *A.racemosus* has never been done. So the work being carried out with combining the two medicinal plants will give more impact towards the resistant and pathogenic bacteria.

6.Conclusion

Naturally available medicinal plants have expressed potential medical features in various researches. Till date many research are on-going for various medicinally valuable plants to be implemented into modern medicine. Notable combinational studies on various medicinal plants are present proving its effective application for bodily ailments. In the future further research has to be done to prove combinational effect of medicinal plants and their probable effect in curing diseases.

7.Future perspective

The plants bioactive compounds can be formulated into drugs and can be commercialised acting as replacement for some modern medicines. Various studies on the combination of *M.koenigii*and *A.racemosus*can be done such as the extracts antibacterial effect against hospital derived MRSA infection. The active compounds present in the extract might inhibit the bacterial growth and infection. Furthermore, as these plants are naturally available they can replenish and can be easily attained. Thus, when their product derivatives are commercialised, they will be accessible by all class of people.

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9.References

1. Biswas AK, Chatli MK, Sahoo J. Antioxidant potential of curry (Murrayakoenigii L.) and mint (Menthaspicata) leaf extracts and their effect on colour and oxidative stability of raw ground pork meat during refrigeration storage. Food Chemistry. 2012 Jul 15;133(2):467-72.
2. Alok S, Jain SK, Verma A, Kumar M, Mahor A, Sabharwal M. Plant profile, phytochemistry and pharmacology of Asparagus racemosus (Shatavari): A review. Asian Pacific journal of tropical disease. 2013 Jun;3(3):242.
3. Ates DA, Turgay O. Antimicrobial activities of various medicinal and commercial plant extracts. Turkish Journal of Biology. 2003 Sep 4;27(3):157-62.
4. Bopana N, Saxena S. Asparagus racemosus—Ethnopharmacological evaluation and conservation needs. Journal of ethnopharmacology. 2007 Mar 1;110(1):1-5.
5. B Aggarwal B, Prasad S, Reuter S, Kannappan R, R Yadav V, Park B, Hye Kim J, C Gupta S, Phromnoi K, Sundaram C, Prasad S. Identification of novel anti-inflammatory agents from Ayurvedic medicine for prevention of chronic diseases:"reverse pharmacology" and "bedside to bench" approach. Current drug targets. 2011 Oct 1;12(11):1595-653.
6. Chaudhary D, Paudel S, Rana RM, Timsina S, Malla KP, Giri PM, Neupane BP. Inhibition of calcium oxalate crystallization in vitro by methanolic leaf extract of Murrayakoenigii (L.) Spreng. Methods. 2018;17:18.
7. Folk Medicine | Encyclopedia.com [Internet]. Encyclopedia.com. 2018 [cited 27 December 2018]. Folk Medicine [Internet]. Kultur.gov.tr. 2018 [cited 27 December 2018].
8. Goutam M.P. and Purohit R.M., Antimicrobial activity of the essential oil of the leaves of Murrayakoenigii. Indian J of Pharms, 36, 11 (1974)
9. Gupta S, George M, Singhal M, Sharma GN, Garg V. Leaves extract of MurrayaKoenigiilinn for anti-inflammatory and analgesic activity in animal models. Journal of advanced pharmaceutical technology & research. 2010 Jan;1(1):68.
10. Goyal RK, Singh J, Lal H. Asparagus racemosus-An update. Indian journal of medical sciences. 2003 Sep 1;57(9):408-14.
11. Goel RK, Sairam K. Anti-ulcer drugs from indigenous sources with emphasis on Musa sapientum, tamrahbasma, Asparagus racemosus and Zingiberofficinale. Indian Journal of Pharmacology. 2002 Jan 1;34(2):100-10.
12. Hannan JM, Ali L, Khaleque J, Akhter M, Flatt PR, Abdel-Wahab YH. Antihyperglycaemic activity of Asparagus racemosus roots is partly mediated by inhibition of carbohydrate digestion and absorption, and enhancement of cellular insulin action. British Journal of Nutrition. 2012 May;107(9):1316-23.
13. Helmenstine AM, Helmenstine. This List of Plant-Derived Medicines May Surprise You [Internet]. ThoughtCo. [cited 2018Nov3].
14. Iyer D, Devi U. Phyto-pharmacology of Murrayakoenigii (L.). Pharmacognosy Reviews. 2008;2(3):180.
15. Kiyohara H, Matsumoto T, Yamada H. Combination effects of herbs in a multi-herbal formula: expression of Juzen-taiho-to's immuno-modulatory activity on the intestinal immune system. Evidence-Based Complementary and Alternative Medicine. 2004;1(1):83-91.
16. Kumar NS, Mukherjee PK, Bhadra S, Saha BP, Pal BC. Acetylcholinesterase inhibitory potential of a carbazole alkaloid, mahanimbine, from Murrayakoenigii. Phytotherapy Research: An International Journal Devoted to Pharmacological and Toxicological Evaluation of Natural Product Derivatives. 2010 Apr;24(4):629-31.
17. Khan BA, Abraham Annie, Leelamma S, Antioxidant Effects Of Curry Leaf Murrayakoenigii And Mustard Seeds, Brasicajuncea In Rats Fed With High Fat Diet, Ind. Jour. Exp. Biol.,1997; 35: 148-150.
18. Kok YY, Mooi LY, Ahmad K, Sukari MA, Mat N, Rahmani M, Ali AM. Anti-tumour promoting activity and antioxidant properties of girinimbine isolated from the stem bark of Murrayakoenigii S. Molecules. 2012 Apr 20;17(4):4651-60.
19. Kusuma IW, Kuspradini H, Arung ET, Aryani F, Min YH, Kim JS, Kim YU. Biological activity and phytochemical analysis of three Indonesian medicinal plants, Murrayakoenigii, Syzygiumpolyanthum and Zingiberpurpurea. Journal of Acupuncture and Meridian Studies. 2011 Mar 1;4(1):75-9.
20. Mandal SC, Nandy A, Pal M, Saha BP. Evaluation of antibacterial activity of Asparagus racemosus wildroot. Phytotherapy Research: An International Journal Devoted to Pharmacological and Toxicological Evaluation of Natural Product Derivatives. 2000 Mar;14(2):118-9.
21. Mandal S, Nayak A, Kar M, Banerjee SK, Das A, Upadhyay SN et.al, Antidiarrhoeal activity of carbazole alkaloids from MurrayakoenigiiSpreng (Rutaceae) seeds. Fitoterapia 2010; 8(1):72-74.
22. Mishra M.K., Sahu R.V., Goojar M., Prajapati N. and Pathak K., Anti-fungal Potential of leaf extract of Murrayakoenigii., Int J Res Aurveda Pharm., 1(2), 549- 552 (2010)
23. Nagappan T, Ramasamy P, Wahid ME, Segaran TC, Vairappan CS. Biological activity of carbazole alkaloids and essential oil of Murrayakoenigii against antibiotic resistant microbes and cancer cell lines. Molecules. 2011 Nov 21;16(11):9651-64.
24. Ningappa MB, Dhananjaya BL, Dinesha R, Harsha R, Srinivas L. Potent antibacterial property of APC protein from curry leaves (Murrayakoenigii L.). Food chemistry. 2010 Feb 1;118(3):747-50.
25. Narasimhan N.S., Paradkar M.V., Chitguppi V.P. and Kelkar S.L., Alkaloids of Murrayakoenigi, Structures of mahanimbine, koenimbine, mahanine, koenine, koenigine and koenidine, Indian J Chem., 13, 993 (1975)

26. Nutan MTH, Hasnat A, Rashid MA, Antibacterial And Cytotoxic Activities Of Murrayakoenigii, Fitoterapia,1998; 69(2):173-175.
27. Patidar K. Development of Polyherbal Shampoo for Antifungal Activity and its Comparison with Commercially Available Shampoo: A Research Article. Asian Journal of Pharmaceutics (AJP): Free full text articles from Asian J Pharm. 2018 Nov 6;12(03).
28. Parmar S, Gangwal A, Sheth N. Mast cell membrane stabilization and anti-histaminic actions–possible mechanism of action of anti-inflammatory action of Murrayakoenigii. J Curr Pharm Res. 2010;2(1):21-5.
29. Prasad GB, Dua VK, Mathur AB. Anti-inflammatory activity of leaves extracts of Murrayakoenigii L. Int J Pharm Biol Sci. 2011;2(1):541-4.
30. Panghal M, Kaushal V, Yadav JP. In vitro antimicrobial activity of ten medicinal plants against clinical isolates of oral cancer cases. Annals of clinical Microbiology and Antimicrobials. 2011 Dec;10(1):21.
31. Potduang B, Meeploy M, Giwanon R, Benmart Y, Kaewduang M, Supatanakul W. Biological activities of Asparagus racemosus. African Journal of Traditional, Complementary and Alternative Medicines. 2008;5(3):230-7.
32. Poh KH, Muhammad N, Abdullah N, Talip BA. The Evaluation of Antioxidant Activity of Individual and Mixture of Lemongrass, Curry Leaves, Turmeric and Ginger Extracts. Journal of Science and Technology. 2018 Aug 1;10(2).
33. Rajendran MP, Pallaiyan BB, Selvaraj N. Chemical composition, antibacterial and antioxidant profile of essential oil from Murrayakoenigii (L.) leaves. Avicenna journal of phytomedicine. 2014 May;4(3):200.
34. Roy MK, Thalang VN, Trakoontivakorn G, Nakahara K. Mechanism of mahanine-induced apoptosis in human leukemia cells (HL-60). Biochemical pharmacology. 2004 Jan 1;67(1):41-51.
35. Scope and importance of traditional medicine [Internet]. Niscair.res.in. 2018 [cited 27 December 2018].
36. Sharma S, Arora S. Pharmaceutical activities of Phytochemicals in Murraya spp.-a review. Journal of Pharmacy Research. 2015 May 5:217-36.
37. Sepahpour S, Selamat J, Abdul Manap MY, Khatib A, AbdullRazis AF. Comparative Analysis of Chemical Composition, Antioxidant Activity and Quantitative Characterization of Some Phenolic Compounds in Selected Herbs and Spices in Different Solvent Extraction Systems. Molecules. 2018 Feb 13;23(2):402.
38. Sekine T, Ikegami F, Fukasawa N, Kashiwagi Y, Aizawa T, Fujii Y, Ruangrungsi N, Murakoshi I. Structure and relative stereochemistry of a new polycyclic alkaloid, asparagamine A, showing anti-oxytocin activity, isolated from Asparagus racemosus. Journal of the Chemical Society, Perkin Transactions 1. 1995(4):391-3.
39. Shah MA, Abdullah SM, Khan MA, Nasar G, Saba I. Antibacterial activity of chemical constituents isolated from Asparagus racemosus. Bangladesh J Pharmacol. 2014 Jan 1;9:1-3.
40. Suchita M, Dixit PK, Gautam RK, Gupta MM. In Vitro Anti-Inflammatory activity of hydroalcoholic extract of Asparagus racemosus roots. Int J Res. Pharm Sci. 2013;4(2):203-6.
41. Tachibana Y., Kikuzaki H., Lajis N.H., Nakatani N., Antioxidative activity of carbazoles from Murrayakoenigii leaves, J Agric Food Chem., 49(11), 5589–5594 (2001)
42. Umashanker M, Shruti S. Traditional Indian herbal medicine used as antipyretic, antiulcer, anti-diabetic and anticancer: A review. IJRPC. 2011;1(4):1152-9.
43. Vats M, Singh H, Sardana S. Phytochemical screening and antimicrobial activity of roots of Murrayakoenigii (Linn.) Spreng.(Rutaceae). Brazilian Journal of Microbiology. 2011 Dec;42(4):1569-73.
44. Vadivelan R, Dipanjan M, Umasankar P, Dhanabal SP, Satishkumar MN, Antony S, Elango K. Hypoglycemic, antioxidant and hypolipidemic activity of Asparagus racemosus on streptozotocin-induced diabetic in rats. Advances in applied science research. 2011;2(3):179-85.
45. Venkatesan N, Thiyagarajan V, Narayanan S, Arul A, Raja S, Kumar SV, Rajarajan T, Perianayagam JB. Anti-diarrhoeal potential of Asparagus racemosus wild root extracts in laboratory animals. J Pharm Pharm Sci. 2005 Jan 1;8(1):39-46.
46. Vickers A, Zollman C, Lee R. Herbal medicine. Western Journal of Medicine. 2001 Aug;175(2):125.
47. Wiboonpun N, Phuwapraisirisan P, Pyang S. Identification of antioxidant compound from Asparagus racemosus. Phytotherapy Research: An International Journal Devoted to Pharmacological and Toxicological Evaluation of Natural Product Derivatives. 2004 Sep;18(9):771-3.
48. Xie JT, Chang WT, Wang CZ, Mehendale SR, Li J, Ambihaipahar R, Ambihaipahar U, Fong HH, Yuan CS. Curry leaf (MurrayakoenigiiSpreng.) reduces blood cholesterol and glucose levels in ob/ob mice. The American Journal of Chinese Medicine. 2006;34(02):279-84.
49. Zhang M, Hettiarachchy NS, Horax R, Kannan A, Praisoody A, Muhundan A. Phytochemicals, antioxidant and antimicrobial activity of Hibiscus sabdariffa, Centellaasiatica, Moringaoleifera and Murrayakoenigii leaves. Journal of Medicinal Plants Research. 2011 Dec 16;5(30):6672-80.