Asian Journal of Pharmacy and Life Science ISSN 2231 – 4423
Vol.3 (3), July-Sept, 2013

AN ETHNO-PHYTO-PHARMACOLOGICAL OVERVIEW OF TWO NOVEL INDIAN MEDICINAL HERBS USED IN POLYHERBAL FORMULATIONS

Pulak Majumder*[1] and M. Paridhavi[2]
[1]Research scholar, CRD, PRIST University, Vallam, Thanjavur, Tamilnadu--613403
[2]Rajiv Gandhi institute of Pharmacy, Trikaripur, Kasaragod dist. Kerala-671310
***Corresponding author,s Email:** pulak2007@gmail.com Mob no- 07736404410

ABSTRACT

Medical plants play an important role in the health care management and different clinical problems in developing countries and developed countries as well. Medicinal plants in Indian sub continent have a tremendous role since from the Vedic eras and also in recent advances on the field of herbal medicines. It has been proved that the medicinal plants are the main sources of chemical substances with potential therapeutic and pharmacological effects. Various phyto compounds were characterized from plants which are now using in the treatment of many diseases either in single or combination formulations. The present paper reviews the up to date literature on recent ethno medicinal uses with pharmacological screening of every plant part of different two medicinal plants, i.e Trichosynthes dioica and Mangifera indica and their phytochemical properties used for the treatment of various ailments in human civilization as well as used in folk medicine as a remedy. The name and parts of the plant studied, the spectrum of activity, and methods used are discussed in this review paper.

KEY WORDS: *Medicinal Plants, Ethno medicinal use, Phytochemistry, Pharmacological Screening.*

INTRODUCTION

Herbs are the best gift by the nature to mankind. In Ayurveda, it is clearly mentioned that any patients can be cured with the help of herbs in the surroundings. There are two types of illness described in Ayurveda, preventive and curative[1]. On that fundamental basis of Ayurveda various medicinal formulations has been made and using since 5000 years in various human aliments which had well documented in various ancient literatures. Traditional medicinal systems use plants as an indispensible source of medicinal preparations. More than thousands of plant species are recognized as having medicinal value and called as 'Phytomedicines'. Besides the remarkable development of synthetic medicine in recent era may lead to little suppression of the traditional herbal medicine in various ways but it must not be denied that till date 80% population of this world as specially India like developing countries still depends on traditional medicines for their regular health problems. On growing adverse effect of synthetic medications as especially in the field of cosmetology, people now readily shifts to the drugs from herbal origin.

India is well known for its rich traditional system of medicine, i.e. Auyrveda, Siddha, Unani and Tibetan besides a vast reservoir of living traditions of ethno medicine. Medicinal plant flora of some 25,000 species of these 150 species is commercially used for extracting medicines or drug formulation. Underline the medical culture of India both folk traditions as well as codified knowledge system is a deep understandings of the medicinal value of the plants starting with the references in the Atharveda. We have textual evidence of a tradition of use of medicinal plants that is more than 3000 years old. Over the last few years, researchers have aimed at identifying and validating plants derived substances for the treatment of various diseases. Interestingly, it is estimated that more than 25% of modern medicines are directly or indirectly derived from plants. In this context, it worth mentioning that Indian plants are considered a vast source of several pharmacologically active principles and compounds that are commonly used in

home remedies against multiple ailments [2,3]. Indian medicinal plants are widely used by all sections of the population and it has been estimated that over 7500 species of plants are used by several ethnic communities.

The focus of this review is to provide information's on the phytochemicals, ethnomedicinal uses and pharmacological activities of this medicinal plants (*Trichosynthes dioica* and *Mangifera indica*) commonly used in Indian traditional medicine. These plants are known to contain various active principles of therapeutic value and to possess biological activity against a number of diseases.

No comprehensive accounts on together of these plants are available as a review. NCBI (Pubmed) and Medbioworld databases were used for the collection of pharmacological activities. As well as, ethnomedicinal information was extracted from the book on Dictionary of Indian Folk Medicine and Ethnobotany and some related publications which are published on the ethnobotanical aspects. The medicinal properties and plant characteristics were collected from the published books on Indian Medicinal Plants and Indian Materia Medica.

MANGIFERA INDICA

Mangifera indica L. is a large evergreen tree, long living, 10-45 m high with a strong trunk and heavy crown. Native from tropical Asia, it has been introduced wherever the climate is sufficiently warm and damp and is now completely naturalized in many parts of tropics and subtropics[4].

Vernacular names		**Taxonomical classification**	
Sanskrit:	Ambrah	Kingdom	Plantae
English:	Mango	Subkingdom	Tracheobionta
Hindi:	Aam	Superdivision	Spermatophyta
Tamil:	Ambiram	Division	Magnoliophyta
Punjabi:	Amb, Wawashi	Class	Magnoliopsida
Gujarati:	Ambo	Subclass	Rosidae
Kashmiri:	Amb	Order	Sapindales
Malayalam:	Amram, Manga	Family	Anacardiaceae
Marathi:	Amchur, Amba	Genus	Mangifera L.
Bangali:	Aam	Species	*Mangifera indica* L.

Fig.1 *Mangifera indica*

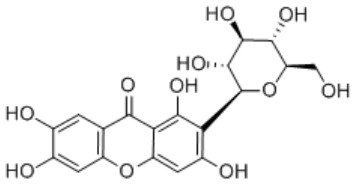
Ethanmedicinal Review

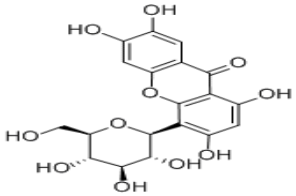
The root, bark, leaves, flowers; unripe and ripe fruit are acrid, cooling and astringent to the bowels and have been employed to cure "vata", "pitta", and "kapha". The parts of *M. indica* mentioned above have also been employed traditionally for treatment of leucorrhoea, bad blood; dysentery, piles, bronchitis, biliousness, urinary discharges, throat troubles, vaginal troubles, hiccough, ophthalmic, eruption, asthma and labouring under habitual constipation. It is also used as aphrodisiac, tonic, appetizer, beautifier of complexion, hiccough, laxative, diuretic, stomachic, antisyphilitic and for tanning purposes in various parts of the world[5]. The widely available leaves of *M. indica* traditionally known to be useful for the treatment of wide panel of disease like throat infection, burns, scalds[6], antidiabetic[7], antioxidant[8], antimicrobial[9], antiviral[10] and antibacterial[11].

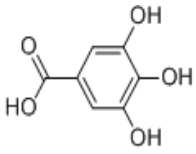
Phytochemical Review

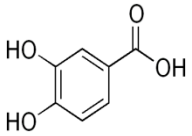
Different chemical constituents like polyphenolics, flavonoids, triterpenoids etc has been isolated from *Mangifera indica*. Mangiferin, a xanthone glycoside, found as major bio-active constituent, isomangiferin, tannins & gallic acid derivatives also present. The bark is reported to contain protocatechic acid, catechin, mangiferin, alanine, glycine, γ-aminobutyric acid, kinic acid, shikimic acid and the tetracyclic triterpenoids cycloart-24-en-3β,26diol, 3-ketodammar-24 (*E*)-en-20S,26-diol, C-24 epimers of cycloart-25 en 3β,24,27-triol and cycloartan-3β,24,27-triol[12].

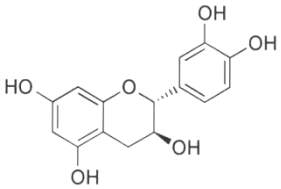
Stem Triterpenoids (29-hydroxymangiferonic acid, Mangiferonic acid, Mangiferolic acid, Hydroxymangiferolic acid, 3α-22ξ-dihydroxycycloart-24E-en-26-oic acid), Sitosterol arachidate, Friedelin, Friedelan-3β-ol, β-sitosterol, Epi-Ψ-taraxastane-3β ,20-diol, The mixture of 6β-hydroxystigmast-4-en-3-one, 6β hydroxycampest-4-en-3-one and 6β-hydroxystigmasta-4 ,22-dien-3-one, 5α-stigrnastane-3β, 6α-diol, Cycloartane-3β ,24,25-triol, Phenolic acids (gallic acid, 3,4-dihydroxy benzoic acid, gallic acid methyl ester, mangiferin, (+)-catechin, (-)-epicatechin[13-18]. Benzoic acid, benzoic acid propyl ester, Saponins (indicoside A, indicoside B), Triterpenoids (25 (R)-3-oxo-methylene cycloartan-26-ol, Ψ-taraxastanonol, cycloart-24-ene-3β ,26-diol, C-24 epimers of cycloart-25-ene-3β, 24 ,27-triol, the C-24 epimers of cycloartane-3β ,24,25-trio1, 3-ketodammar-24E-ene-2OS, 26diol, hopane-lβ, 3β ,22-triol) , manghopanal, mangoleanone, mangsterol, manglupenone, mangocoumarin, n-tetacosane, n-heneicosane, n-triacontane , Mangostin, An unusual fatty acid, cis-9, cis-15-octadecadienoic acid was isolated from the pulp lipids of mango. Phenolic Antioxidants, Free Sugars and Polyols isolated and analyzed from Stem Bark[19]. 5 - [12 (Z)-heptadecenyl] resorcinol / Mangol II was found in milk of this tree.Fruit contains Gallotannins (penta-, hexa-, and hepta-O-galloylglucose[20]. The flower yielded alkyl gallates such as gallic acid, ethyl gallate, methyl gallate, n-propyl gallate, n-pentyl gallate, n-octyl gallate, 4-phenyl gallate, 6-phenyl-n-hexyl gallate and dihydrogallic acid[21]. Root of mango contains Friedelin, chromones, 3-hydroxy-2-(4'-methylbenzoyl)-chromone and 3-methoxy-2-(4'-methyl benzoyl)-chromone. Leaves also contains Friedelin, Taraxerol, Taraxerone, Lupeol The leaf and flower yield an essential oil containing humulene, elemene, ocimene, linalool, nerol and many others. The fruit pulp contains vitamins A and C, β-carotene and xanthophylls the presence of a phenolic compound from leaves which was named as homomangifirin[22]. 5-Alkyl- and 5-alkenylresorcinols, as well as their hydroxylated derivatives, extracted from peels[23] the bioactive marker compound mangiferin in the stem bark & leaves. Friedelin, Friedelan -3β-ol, Cycloartenol, α- amyrin, β-amyrin, Mangiferonic acid, Mangiferolic acid was isolated from root bark. Steam bark also contains Cycloartenol [24] .The volatile composition of *M. indica* a total of 19 different compounds, were identified. Sesquiterpene hydrocarbons were shown to be the main group of constituents of all taxa. The main constituents of the oil were α-gurjunene (24.0%), β-selinene (24.0%), β-caryophyllene (11.2%), α-humulene (7.2%), caryophyllene oxide (5.5%) and humulene epoxide (2.4%).

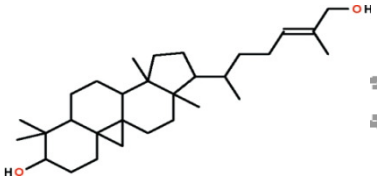

Mangiferin

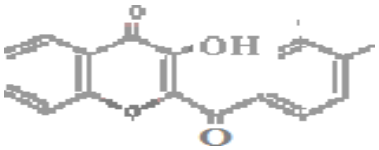

Isomangiferin

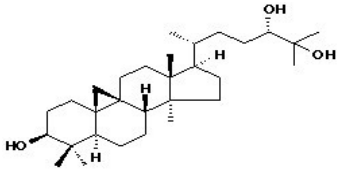

Gallic acid

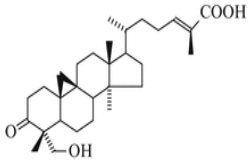

Protocatechuic acid

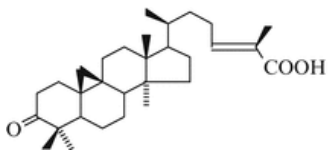

Catechin

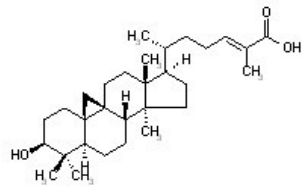

Cycloart-24-en-3β ,26diol


3-methoxy-2-(4'-methyl, benzoyl)-chromone

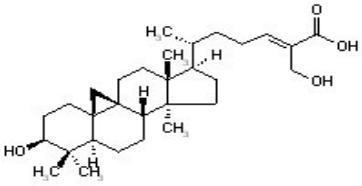

Cycloartan-3β,24,27-triol


29-hydroxymangiferonic acid

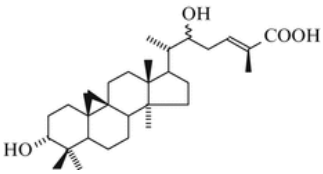

Mangiferonic acid



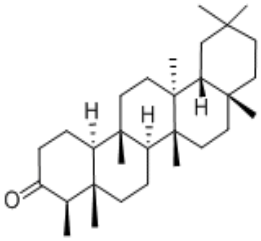
Mangiferolic acid



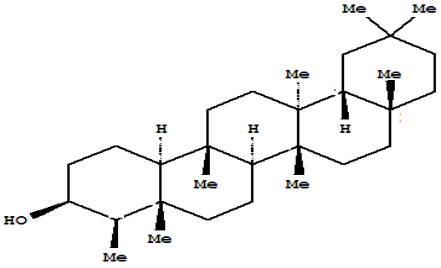
Hydroxymangiferolic acid



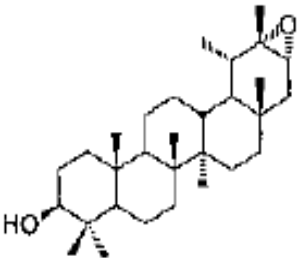
3α-22ξ-dihydroxycycloart -24E-en-26-oic acid



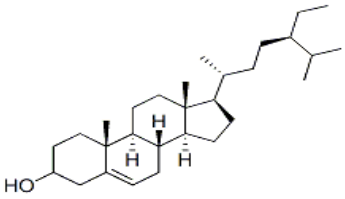
Friedelin



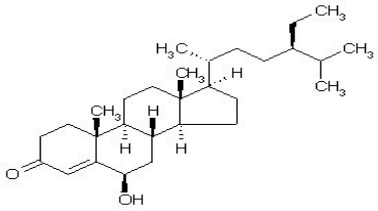
Friedelan-3β-ol



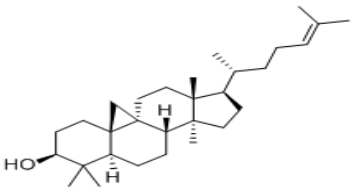
Epi-Ψ-taraxastane-3β ,20-diol



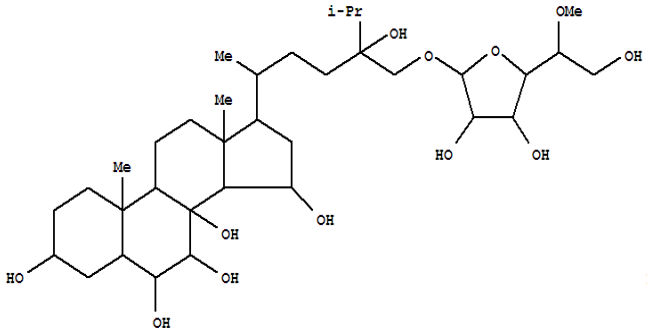
β-sitosterol



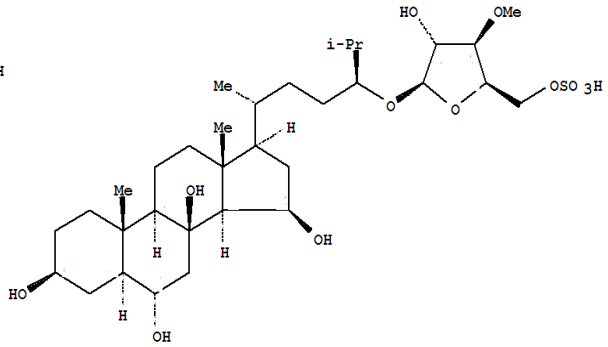
6β-hydroxystigmast-4-en-3-one



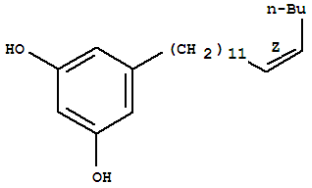
Cycloartenol



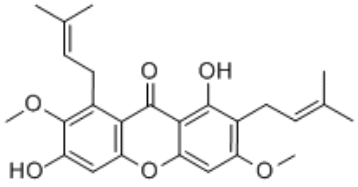
Indicoside A



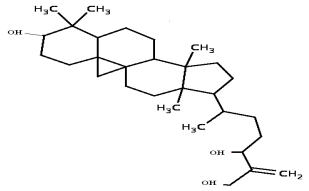
Indicoside B



5 - [12 (Z)-heptadecenyl] resorcinol / Mangol II



3-hydroxy-2-(4'-methylbenzoyl) -chromone



Cycloart-25 en 3β,24,27-triol

Pharmacological review

Pharmacological activity	Plant Parts used	Extract used (solvents)	Screening models	Reference
Anti-oxidant activity	Pulp Stem bark	 Aqueous extract	Total phenolics, carotenoids and ascorbic acid Fe2+-citrate-induced lipoperoxidation	Martinez G *et al*, (2000)[25], Pardo-Andreu GL *et al*, (2006)[26], Rocha Ribeiro SM *et al*, (2007)[27], Gabino G *et al*, (2008)[28], Pardo Andreu G *et al*, (2005)[29]
Anti-diabetic Activity	Leaves Leaves Stem-bark	Ethanol extract Aqueous extract Ethanol extract	Normal and streptozotocin-induced diabetic animals. Blood glucose level in normoglycaemic, glucose - induced hyperglycaemic and streptozotocin (STZ)-induced diabetic Ratsperfusion study	Sharma SR *et al*, (1997)[30] Aderibigbe AO *et al*, (1999)[31], Aderibigbe AO *et al*, (2001)[32], Perpétuo GF *et al*, (2003)[33] Ojewole JA *et al*, (2005)[34], Amrita B *et al*, (2009)[35], Muruganandan S *et al*, (2005)[36], Rolo AP *et al*, (2006)[37]
Antiviral activity		Isolated compound	Against herpes simplex virus type 2 in vitro,	Zhu XM *et al*, (1993)[38], Zheng MS *et al*, (1990)[39], Guha S *et al*, (1996)[40]
Anthelmintic and anti-allergenic activity	Stem bark	Isolated compound		Garcia D *et al*, (2003)[41], Rivera DG *et al*, (2006)[42]
Anti-tumor-anti-HIV activity	Stem bark Arial parts	 Ethanol/water (1:1) extract	Against the breast cancer cell lines MCF 7, MDA-MB-435 and MDA-N, colon cancer cell line (SW-620, renal cancer cell line (786-0). Proliferation of K562 leukemia cells	Muanza DN *et al*, (1995)[43], Aswal BS *et al*,(1984)[44]. Peng ZG *et al*,(2004)[45], Yoshimi N *et al*, (2001)[46].
Antibacterial activity		Pet ether, ethyl acetate , ethanolic extract	Against agclinical strains of bacteria S. typhi, B.subtilis, E.coli and K. pneumonia.	Doughari, J. H. *et al*,. (2008)[47]
Anti inflammatory activity	Leaves	Aqueous extract	Carrageenan induced rat paw edema and cotton pellet granuloma.	K.P. Latha *et al*,. (2012)[48]
Hepatoprotective activity	Seed kernels	Isolated compound from ethanolic extract	Against liver injury in rats induced by carbon tetrachloride	Saruth Nithitanakool *et al*., (2009)[49]
Radioprotective effect		Isolatd compound (mangiferin)	Radiation-induced micronuclei formation in cultured human peripheral blood lymphocytes and in DBAxC57BL mice	Jagetia GC *et al*., (2005)[50]
Lipolytic activity		Isolated compound (mangiferin)	On rat epididymal fat-derived cultured adipocytes.	Yoshikawa M et ai., (2002)[51]

TRICHOSANTHES DIOICA ROXB.

Trichosanthes, a genus of family *Cucurbitaceae* is an annual or perennial herb distributed in tropical Asia, Polynesia, & Australia. Over 20 species are recorded in India of which two namely *T. anguina & T. dioica* are cultivated as vegetable.

Vernacular Names

English:	Pointed gourd
Hindi:	Parwal, Parvar
Bengali:	Patol.
Gujrati:	Potala, Patal.
Kananda:	Kadupodavalu.
Malyalam:	Patolam.
Punjabi:	Palwal, Parwal.
Tamil:	Peyu-padal.
Te1egu:	Adavi-patola.
Oriya:	Patal.

Taxonomical classification

Kingdom	Plantae
Division	Magnoliophyta
Class	Magnoliopsida
Order	Cucurbitales
Family	Cucurbitaceae
Genus	Trichosanthes
Species	*Trichosanthes dioica*

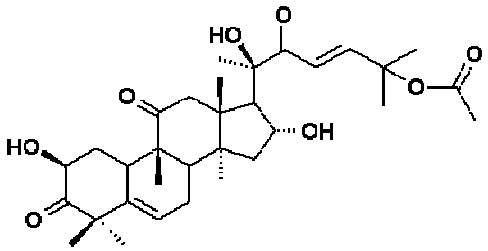
Fig.2 *Trichosanthes dioica*

Ethno pharmacological Review

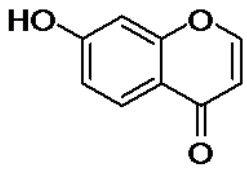
Trichosanthes dioica is known for the important vegetables[52]. The fruits and leaves are the edible parts of the plant which are cooked in various ways either alone or in combination with other vegetables or meats[53]. Juice of leaves of *T. dioica* is used as tonic, febrifuge & in sub acute cases of enlargement of liver & spleen[54]. In Charaka Samhitha, leaves & fruits used for treating alcoholism & jaundice. Leaves are used in odema and alopecia[55]. It is also used as antipyretic, diuretic, cardio tonic & laxative.

Phytochemical Review

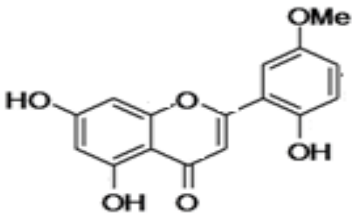
Chemical study reveals that in addition to a number of tetra and pentacyclic triterpenes, the toxic bitter principles Cucurbitacins (a group of often highly oxygenated tetracyclic compounds with a unique carbon skeleton and almost a carbonyl group in ring C) may be considered as a taxonomic character of Cucurbitaceae. *T.dioica* is rich in vitamins and contains 9.0 mg Mg, 2.6 mg Na, 83.0 mg K, 1.1 mg Cu, and 17.0 mg S per 100 g edible part[56]. The various chemical constituents present in *T. dioica* are vitamin A, vitamin C, tannins, and saponins. Two main phytosterols present in *T. dioica* are namely, 24α-ethylcholest-7-enol & 24β-ethylcholest-7-enol[57]. Also seeds of *T. dioica* contain lectin, a carbohydrate (specifically galactose) binding protein which is homologous to Type-II ribosome inhibitory proteins (Type-II RIP) [58]. Leaves contain 0.97% hentriacontane, chlorophylls, phytin, resins and anthaquinone derivatives.



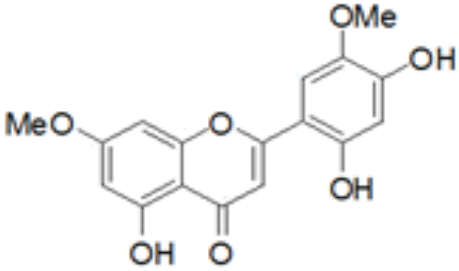
Cucurbitacins



7-Hydroxy-4*H*- 5-chromen-4-one.



5,7-dihydroxy-2-(2- hydroxy-5- methoxyphenyl)-4*H*-chromen-4-one.



5-Hydroxy-2-(2,4- dihydroxy- methoxyphenyl)-7-
Methoxy 4*H*- chromen-4-one.

Pharmacological Review

Pharmacological activity	**Plant Parts used**	**Extract used (solvents)**	**Screening models**	**Reference**
Antidiabetic Activity	Leaves, Fruits	Aqueous extract	Normal and streptozotocin (STZ) induced sub- and mild-diabetic rats	Chandrasekhar B *et al*., (1988)[59], Rai PK *et al*,. (2008)[60], Rai DK *et al*,. (2008)[61],
Hepatopotective Activity	Whole plant	Aqueous and ethanolic extract	Ferrous Sulphate-induced liver injury.	Ghaisas MM *et al*., (2008)[62].
Cholesterol-Lowering Activity	Fruit	Aqueous extract, alcoholic extract	Normal and streptozotocin diabetic rats	Sharmila *et al*. (2007)[63], Sharma *et al*. (1992)[64]
Anti-Inflammatory Activity		Polyherbal formulation (Jatyadi Ghrita)	Carrageenan induced rat paw edema	Fulzul *et al*. (2001)[65]
Antifungal Activity	Seeds	Fixed oil		Hariti *et al*. (1996)[66]
Antibacterial Activity	Seeds	Fixed oil	Disc diffusion method	Hariti *et al*. (1995)[67], Rai PK *et al*. (2010)[68]
Anti-Oxidant Activity	Fruit	Aqueous extract	1, 1 diphenyl-2- picryl hydrazyl, nitric oxide, reducing power assay and hydrogen peroxide radical method.	Shivhare *et al*. (2010)[69]
Wound Healing Activity	Whole plant	Methanolic extract	Burn wound model in rats	Shivhare *et al*. (2010)[70]
Gastric Antiulcer Activity	Leaves	Aqueous extract		Singh KP *et al*, (1985)[71]

CONCLUSION

In this review article, an attempt has been made to compile the reported information about medicinal values of *Trichosynthes dioica* and *Mangifera indica* has paramount importance in Pharmacy and ethno herbal utility. Moreover, it can be initiative for further phytochemical and pharmacological investigations about the medicinal use of the plant and probable herbal formulations, which may be a step ahead towards the new drug development and may be useful to the health professionals, scientists and scholars working the field of pharmacology and therapeutics

to develop evidence-based alternative medicine to cure different kinds of diabetes in man and animals. These plants are also proven to be very valuable to the discovery and utilization of medicinal natural products.

ACKNOWLEDGEMENT

Authors are thankful to the PRIST University for their co-operation and facilitation for success fully completion of this review work.

REFERENCE

1. Upadhyay, S.N.: Immunomodulation. Narosa Publishing House, New Delhi,1997.
2. Biswas K, chattopadhyay I, Banerjee RK & Bandyopadhyay U. Biological activities and medicinal properties of neem (Azadirachta indica). Curr sci. 2002; 82:1336.
3. Bandopadhyay U, Biswas K, Chatterjee R, Bandopadyay D, chattopadhyay I, Ganguly C K, Chakraborty T, Bhattacharya K, & Banerjee RK. Gastroprotective effect of Neem(Azadirachta indica) bark extract: possible involvement of H+-K+-ATPase inhibition and scavenging of hydroxyl radical. Life sci. 2002; 71: 2845.
4. Ross IA. Medicinal Plants of the world, Chemical constituents, Chemical constituents. Traditional and Modern Medicinal Uses, Humana Press, Totowa. 1999; p. 197-205
5. Anonymous. “The Wealth of India- Raw materials”. Vol. VI:L-M; 1962. P. 281.
6. Anonymous, “The Wealth of India- Raw materials”. Vol VI:L-M; 2005. P. 280.
7. Muruganandan.S, Scrinivasan.K, Gupta.S, Gupta.P.K and Lal.J. Effect of mangiferin on hyperglycemia and atherogenicity in streptazotocin diabetic rats. J ethnopharm. 2005; 97: 497-501.
8. Badmus.J.A, Adedosu.T.U, Fatoki.J.O, Adegbite.V.S, Adaramoye.O.A, Odunola.O.A. Lipid peroxidation inhibition and antiradical activities of some leaf fractions of Mangifera indica. Acta Pol Pharm. 2011; 68(1) :23-9.
9. Enikuomehin.O.A, Ikotun.T, Ekpo.E.J. Evaluation of ash from some tropical plants of Nigeria for the control of sclerotium rolfsii sacc. On wheat (Triticum aestivum L.). Mycopathologia. 1998;142(2):81-7.
10. Zhu.X.M, Song.J.X, Huang.Z.Z, Whu.Y.M and Yu.M.J. Antiviral activity of Mangiferin against herpes simplex virus type 2 in vitro. ZhongguoYaoliXuebao.193; 14: 452-4.
11. Godfrey S,Bbosa, Aloysius Lubega, Nathan Musisi, David B, Kyegombe, Paul Waako, Jasper Ogwal-Okeng, OlwaOdyek. The activity of Mangifera indica L. leaf extracts against the tetanus causing bacterium, clostridium tetani. Afri J of Ecology. 2007; 45:54-8.
12. Ngozi.O Awa-Imaga. Possible anti-trypanosomal effect of aqueous leaf extracts of Mangifera indica on plasma proteins of Trypanosomacongolense- infected rats. J pharmacog and phytotherapy.2011; 3(8):137-40.
13. Scartezzini P, Speroni E. Review on some plants of Indian traditional medicine with antioxidant activity. J Ethnopharmacol. 2000;71:23–43.
14. Anjaneyulu V, Babu JS, Connolly JD. 29-Hydroxymangiferonic Acid from Mangifera-Indica. Phytochem. 1994; 35: 1301-3.
15. Selles AJN, Castro HTV, Aguero-Aguero J, Gonzalez-Gonzalez J, Naddeo F, De Simone F, Rastrelli L. Isolation and quantitative analysis of phenolic antioxidants, free sugars, and polyols from mango (Mangifera indica L.) stem bark aqueous decoction used in Cuba as a nutritional supplement. J Agri and Food Chem. 2002; 50: 762-6.
16. Khan MN, Nizami SS, Khan MA, Ahmed Z. New saponins from Mangifera indica. J Nat Prod. 1993 ; 56: 767-70.

17. Anjaneyulu V, Satyanarayana P, Viswanadham KN, Jyothi VG, Rao KN, Radhika P. Triterpenoids from Mangifera indica. Phytoche. 1999; 50: 1229-36.
18. Anjaneyulu V, Prasad KH, Ravi K, Connolly JD. Triterpenoids from Mangifera-Indica. Phytochem. 1985 ; 24: 2359-67.
19. Anjaneyulu V, Ravi K, Prasad KH, Connolly JD. Triterpenoids from Mangifera-Indica. Phytochem. 1989 ; 28: 1471-7.
20. Shibahara A, Yamamoto K, Shinkai K, Nakayama T, Kajimoto G. Cis-9, cis-15-octadecadienoic acid:a novel fatty acid found in higher plants. Biochimi Biophy Acta. 1993;1170:245–52.
21. Bandyopadhyay C, Gholap AS, Mamdapur VR. Characterization of Alkenylresorcinol in Mango (Mangifera-Indica L) Latex. J Agri and Food Chem. 1985; 33: 377-9.
22. Khan MA, Khan MN. Alkyl gallates of flowers of *Mangifera Indica*. Fitoterapia. 1989;60:284.
23. V. Anjaneyulu , P.Radhika. The terpenoids and steroids from Mnagifera Indica Linn. Ind J chem. 2000; 39(B):883-93
24. Knödler M, Berardini N, Kammerer DR, Carle R, Schieber A. Characterization of major and minor alk(en)ylresorcinols from mango (*Mangifera Indica* L.) peels by high-performance liquid chromatography/atmospheric pressure chemical ionization mass spectrometry. Rapid Commun Mass Spectrom. 2007;21:945–51.
25. Martinez G, Delgado R, Perez G, Garrido G, Nunez Selles AJ, Leon OS. Evaluation of the *in-vitro* antioxidant activity of *Mangifera indica* L: Extract (Vimang). Phytother Res. 2000;14:424–7.
26. Pardo-Andreu GL, Sanchez-Baldoquín C, Avila-González R, Yamamoto ET, Revilla A, Uyemura SA, *et al*. Interaction of Vimang (*Mangifera indica* L.extract) with Fe(III) improves its antioxidant and cytoprotecting activity. Pharmacol Res. 2006; 54:389–95.
27. Rocha Ribeiro SM, Queiroz JH, Lopes Ribeiro ME, Campos FM, Pinheiro Santana HM. Antioxidant in mango (*Mangifera indica* L.) pulp. Plant Foods Hum Nutr. 2007;62:13–7.
28. Gabino G, Deyarina G, Cheyla R, Nunez-Selles AJ, Rene D. Scavenger effect of a mango (*Mangifera indica* L.) food supplement's active ingredient on free radicals produced by human polymorphonuclear cells and hypoxanthine–xanthine oxidase chemiluminescence systems. Food Chem. 2008;107:1008–14.
29. Pardo Andreu G, Delgado R, Velho J, Inada NM, Curti C, Vercesi AE. *Mangifera Indica* L.extract (Vimang) inhibits Fe^{2+} citrate-induced lipoperoxidation in isolated rat liver mitochondria. Pharmacol Res. 2005;51:427–35.
30. Sharma SR, Dwivedi SK, Swarup D. Hypoglycemic potential of Mangifera indica leaves in rats. Int J Pharmaco. 1997;35:130.
31. Aderibigbe AO, Emudianughe TS, Lawal BA. Antihyperglycaemic effect of Mangifera indica in rat. Phytother Res. 1999;13:504–7.
32. Aderibigbe AO, Emudianughe TS, Lawal BA. Evaluation of the antidiabetic action of Mangifera indica in mice. Phytother Res. 2001;15:456–8.
33. Perpétuo GF, Salgado JM. Effect of mango (Mangifera indica, L.) ingestion on blood glucose levels of normal and diabetic rats. J Plant Foods Hum Nutr. 2003;58:1–12.
34. Ojewole JA. Antiinflammatory, analgesic and hypoglycemic effects of Mangifera indica Linn.(Anacardiaceae) stem-bark aqueous extract. Methods Find Exp Clin Pharmacol. 2005;27:547–54.

35. Amrita B, Liakot A, Masfida A, Begum R. Studies on the antidiabetic effects of Mangifera indica stem-barks and leaves on nondiabetic, type 1 and type 2 diabetic model rats. Bangladesh J Pharmacol. 2009;4:110–4.
36. Muruganandan S, Scrinivasan K, Gupta S, Gupta PK, Lal J. Effect of mangiferin on hyperglycemia and atherogenicity in streptozotocin diabetic rats. J Ethnopharmacol. 2005;97:497–501.
37. Rolo AP, Palmeira CM. Diabetes and mitochondrial function: Role of hyperglycemia and oxidative stress. Toxicol Appl Pharmacol. 2006;212:167–78.
38. Zhu XM, Song JX, Huang ZZ, Whu YM, Yu MJ. Antiviral activity of mangiferin against herpes simplex virus type 2 in vitro. Zhongguo Yao Li Xue Bao. 1993;14:452–4.
39. Zheng MS, Lu ZY. Antiviral effect of mangiferin and isomangiferin on herpes simplex virus. Chin Med J. 1990;103:160–5.
40. Guha S, Ghosal S, Chattopadyay U. Antitumor, immunomodulatory and anti-HIV effect of mangiferin: A naturally occurring glucosylxanthone. Chemotherapy. 1996;42:443–51.
41. Garcia D, Escalante M, Delgado R, Ubeira FM, Leiro J. Anthelminthic and antiallergic activities of *Mangifera indica* L.stem bark components Vimang and mangiferin. Phytother Res. 2003;17:1203–8.
42. Rivera DG, Balmaseda IH, Leon AA, Hernandez BC, Montiel LM, Garrido GG, *et al*. Anti-allergic properties of *Mangifera indica* L.extract (Vimang) and contribution of its glucosylxanthone mangiferin. J Pharm Pharmacol. 2006;58:385–92.
43. Muanza DN, Euler KL, Williams L, Newman DJ. Screening for antitumor and anti-HIV activities of nine medicinal plants from Zaire. Int J Pharmacol. 1995;33:98.
44. Aswal BS, Bhakuni DS, Goel AK, Kar K, Mehrota BN, Mukhrjee KC. Screening of Indian plants for biological activity: Part X. Indian J Exp Biol. 1984;22:312–32.
45. Peng ZG, Luo J, Xia LH, Chen Y, Song S. CML cell line K562 cell apoptosis induced by mangiferin. Zhongguo Shiyan Xue Ye Xue Za Zhi. 2004;12:590–4.
46. Yoshimi N, Matsunaga K, Katayama M, Yamada Y, Kuno T, Qiao Z, *et al*. The inhibitory effects of mangiferin: A naturally occuring glucosylxanthone, in bowel carcinogenesis of male F344 rats. Cancer Lett. 2001;163:163–70.
47. Doughari, J. H. and Manzara, S. In vitro antibacterial activity of crude leaf extracts of Mangifera indica Linn. Afri J Microbio Res. 2008;2:67-72.
48. K.P. Latha, M. S. Latha, H. M. Vagdevi, S. B. Virupaxappa. Anti inflammatory activity of Mangifera indica L. Var. Rasapuri Root extracts. J Chem and Pharm Res.2012; 4(1), 333-6.
49. Saruth Nithitanakool, Pimolpan Pithayanukul , Rapepol Bavovada. Antioxidant and Hepatoprotective Activities of Thai Mango Seed Kernel Extract. Planta Med. 2009; 75(10): 1118-23.
50. Jagetia GC, Baliga MS. Radioprotection by mangiferin in DBAxC57BL mice: a preliminary study. Phytomedicine.2005; 12: 209-15
51. Yoshikawa M, Shimoda H, Nishida N, Takada M, Matsuda H. *Salacia reticulata* and its polyphenolic constituents with lipase inhibitory and lipolytic activities have mild antiobesity effects in rats. T J Nutri. 2002*;* 132: 1819-24
52. Kirtikar KR, Basu BD. Indian medicinal plant. 2nd ed. Dehradun: Oriental enterprises; 2001. p. 1543–4.
53. Singh BP, Wayne F. Whitehead Pointed gourd: Potential for temperate climates. J Janick. 1999; 118:27–35.
54. Nadkarni AK. Indian Materia Medica. 3rd ed. Mumbai: Popular prakashan Pvt. Ltd; 1982. p. 1236–7.

55. Khare CP. Encyclopedia of Indian medicinal plants. Berlin, Heidelberg; New York: Springer-Verlag; 2004. p. 457–8.
56. Chopra RN, Nayar SL, Chopra IC, Glossary of Indian Medicinal plants, CSIR, New Delhi, 2002, p.340.
57. Kongton S, Chemical study of bioactive constituents from *Trichosanthes cucumerina* root and fruit juice, Mahidol University, 2003. P.80-5.
58. Ali N, Mohammed Sultan, Kenoth R, Swamy MJ, Purification, physicochemical characterization, saccharide specificity, and chemical modification of a Gal/GalNAc specific lectin from the seeds of *Trichosanthes dioica.* Arc of Biochem and Biophy. 2004; 432: 212–21.
59. Chandrasekhar B, Mukherjee B, Mukherjee SK, Blood sugar lowering effect of Trichosanthes dioica Roxb. in experimental rat models. Int J Cru Drug Res. 1988; 26: 102–6.
60. Rai PK, Jaiswal D, Singh RK, Gupta RK, Watal G. Glycemic Properties of Trichosanthes dioica leaves. Pharm bio.2008; 46(12): 894-9.
61. Rai DK, Rai PK, Jaiswal D, Sharma B, Watal G. Effect of water extract of Trichosanthes dioica fruits in streptozotocin induced diabetic rats. Ind J Clinical Biochem. 2008; 23 (4): 387-90.
62. Ghaisas MM, Tanwar MB, Ninave PB, Navghare VV, Deshpande T, Hepatoprotective activity of aqueous & ethanolic extract of T. *dioica* in ferrous sulphate induced liver injury. Pharmacologyonline.2008; 3: 127-35.
63. Sharmila BG, Kumar G, Rajasekhara PM. Cholesterol-lowering activity of the aqueous fruit extract of *Trichosanthes dioica* in normal and streptozotocin diabetic rats. J Clin Dia Res.2007; 1(4): 561-69.
64. Sharma G, Pant MC. Influence of alcoholic extract of whole fruit of *T. dioica,* on blood sugar, serum lipids, lipoproteins & faecal sterols in normal albino rabbits. Ind J clinical biochem. 1992; 1: 53-6.
65. Fulzule SV, Satturwar D, Joshi SB, Studies on anti-inflammatory activity of a poly herbal formulation- Jatydi Ghrita. Ind drugs.2001; 39(1): 42-4.
66. Hariti M, Rathee PS. Antifungal activity of the unsaponifiable fraction of the fixed oil of Trichosanthes seeds. Asian J chem.. 1996; 8(1): 180-2.
67. Hariti M, Rathee PS. Antibacterial activity of the unsaponifiable fraction of the fixed oil of *Trichosanthes* seeds. Asian J Chem1995; 7 (4): 909-11.
68. Rai PK, Mehta S, Gupta RK, Watal G. A Novel Antimicrobial Agents *Trichosanthes dioica*. Int J Pharma and Bio Sci.2010; 1(3): 1-9.
69. Shivhare Y, Singh P, Rajak H, Patil UK, Pawar RS. Antioxidant potential of Trichosanthes dioica Roxb (fruits). Phcog J.2010; 2(6): 107-11.
70. Shivhare Y, Singh P and Patil UK, Healing Potential of Trichosanthes dioica Roxb. On Burn Wounds. Res J Pharmacol and pharmacodyn. 2010; 2(2): 168-71.
71. Singh KP, Singh RH, Clinical investigation of importance of *T. dioica*. J Res Ayurveda, siddha. 1985;6(2): 132- 40.