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A phytopharmacological review on an important medicinal plant - *Wrightia tinctoria*

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ABSTRACT

There are variety of plants are present which have applications due to their medicinal values. *Wrightia tinctoria* is a member of the family Apocynaceae. It is small to medium-size deciduous tree. This plant grows up to 18 m tall and to 20 cm with green marks on the stem and producing milky-white resin. The bark of this plant is smooth, somewhat corky and pale grey. Traditionally *Wrightia tinctoria* commonly called as "Jaundice curative tree" in south India. This plant possesses high medicinal value. The *Wrightia tinctoria* is used for the treatment of several diseases including very severe disease like aids and cancer. In this review we want to highlight on different parameters of plant like general description and distribution, microcopy, chemical constituents and traditional uses with special emphasis of pharmacological action like analgesic, antiinflammatory, anthelmintic, antiulcer, antidiabetic, anticancer, and antipyretic and antidysentric activity. This plant is also used in the treatment of skin diseases like psoriasis and as indigo dyes. The whole study gives information to aware the herbal era remedy for development of new development.

Keywords: Pharmacology, phytochemical, Traditional uses, *Wrightia tinctoria*

1. INTRODUCTION

Wrightia tinctoria is an important medicinal plant used in the Indian system of medicine for the treatment of variety of diseases¹ and it possess analgesic², antifertility³, cytotoxic⁴, homeostasis⁵ and antiulcer activity⁶. It is effective in severe viral diseases like HIV (AIDS). In the siddha system of medicine, it is used for the treatment of psoriasis skin diseases. Morphological studies have been carried out to identify the characteristic features of the leaf. Physical data can be represented by the values like moisture content, ash and extractive values. In the quantitative and qualitative determination different phytochemical tests have been used. Chemical profiles of *Wrightia tinctoria* show the presence of lipid, saponin, tannins, alkaloids, phenol, steroids, flavanoids and several other chemical constituents.

2. GENERAL DESCRIPTION AND DISTRIBUTION⁷⁻¹²

Common names

Kannada	: Beppalli, Kodamurki, Kodesige.
Malayalam	: Aiyapala, Kotakappalla.
Sanskrit	: Hvamovaka, Sveta kutaja.
Tamil	: Nilapalai, Irumpalai, Veypale.
Telugu	: Amkudu, Tedla pala.
English	: Pala Indigo plant.

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Wrightia tinctoria is a small and beautiful deciduous tree that grows up to 10 meters. Its leaves are opposite, up to 8-15 cm long and lanceolate. Bark ivory are colored. Flowers are usually seen in the tip of branches, scattered in the inflorescence and whitish and with fragrance. Fruits are long follicles with adhered tips and long up to 50 cm. Seeds are 1-2 cm long. It has a light gray, scaly smooth bark. Native to India and Burma, *Wrightia* is named after a Scottish physician and botanist William Wright (1740 - 1827). From a distance, the white flowers may appear like snowflakes on a tree. The fruits are pendulous and long paired follicles joined at their tips. The hairy seeds are released as the fruit dehisces. The leaves of this tree yield a blue dye called Pala Indigo.

Leaves are simple, opposite, and distichous. The petiole are 2-5 mm long, stout, glabrous with lamina of 3.5-11 x 2-4 cm. Flowers are bisexual, white and scented, in terminal cymes appearing along with new leaves. Fruit of 2 follicular mericarps are 15-45 cm long, slender, smooth, green and cylindrical. Seeds are 16 mm long, black, commate at one end. Flowering and fruiting occurs in month of February-November
Field Tips: Bark pale and smooth. Sap is present.

3. CHEMICAL CONSTITUENTS¹³⁻¹⁴

The mature powdered pods of *Wrightia tinctoria* contain co-occurrence of -amyrin, ursolic acid and oleanolic acid along with -sitosterol. Methanol extract of immature seed pods contain cycloartenone, -amyrin, cycloeucaenol and -sitosterol and wrightial. A new sterol 14 -methylzymosterol in addition to four rare plant sterols, desmosterol, clerosterol, 24-methylene-25-methylcholesterol and 24-dehydropollinastanol have been isolated from seeds. The stem bark of *Wrightia tinctoria* contains -amyrin, lupeol, wrightiadione, -sitosterol and a new triterpenoid.

4. TRADITIONAL USES¹⁵⁻¹⁹

The flowers are used as vegetables. The tender leaves, pods and seeds are also eaten. The wood is extensively used for all classes of turnery. It is made into cups, plates, combs, chessmen, pen-holders, pencils and bedstead legs. It is also used for carving, frames, spoons, small boxes and screens. It is used for making the celebrated channapatna toys and for idols. The wood is suitable for matchboxes, splints and for making bobbins, engraving and printing-blocks, mathematical instruments and rulers. It is also suitable for stained wood inlay-work and for the manufacture of lacquerware articles. The leaves yield a blue dye called Mysore Pala Indigo. The leaves

are eaten by cattle, sheep and goats. In south India, the plant is used for green manuring rice fields. The handsome, jasmine-scented, star-shaped flowers are much esteemed by Hindus for offerings at temples. Bark – antidropsical, tonic, antidysenteric, used in piles, skin diseases; seed-aphrodisiac, astringent, febrifuge, antidysenteric, anthelmintic; bark and seed used in flatulence and bilious troubles.

5. MACROSCOPIC STUDIES OF LEAVES²⁰⁻²³

5.1 Histological studies of Leaf

A thinnest possible section of leaves, was taken and treated with chloralhydrate solution to make the section clear, the sections were also treated with phloroglucinol and Hydrochloric acid in the ration of 1:1 to study lignified tissues.

5.2 Transverse section of leaf

A Transverse section of *Wrightia tinctoria* leaf shows dorsiventral structure. The following are the important tissue in the lamina and midrib region. The T.S. of the leaf is mainly differentiated into three regions.

5.2.1 Upper Epidermis

It is made up of single layered tangentially elongated compactly arranged cells. But epidermal cell present in the midrib region are small oval shaped and covered by a thick cuticle.

5.2.2 Lower Epidermis

It consists of single layered tangentially elongated compactly arranged cells similar to the upper epidermis. The epidermal cells in the midrib regions are small, oval shaped and covered by a thick cuticle.

5.2.3 Mesophyll

Lamina regions are differentiated into palisade and spongy parenchyma. The palisade tissue is extended upto midrib region; the tissue which is present below the palisade is made up of spongy parenchyma. It is 6-9 layered in structure and consist of vascular strands. The midrib region includes vascular bundles are arranged in a ring. The xylem present towards the centre, the phloem towards the periphery. The vascular tissues are surrounded by continuous pericyclic fibres. 2-3 layers of collenchymatous tissue present above the lower epidermis in the

midrib. A strip of collenchymatous appears below the upper epidermis of the midrib regions. Rest of the midrib region is filled with loosely arranged parenchymatous cells. Surface preparation shows paracytic type of stomata. Clusters of calcium oxalate are present in the mesophyll region. It shows the presence of uniseriate, multicellular, (upto 9 celled) covering trichomes in both the surface. The numbers of trichomes are more in the lower of trichomes are more in the lower surface.

6. PHARMACOLOGICAL ACTIVITIES

6.1 Wound Healing Activity²⁴

The ethanol extract of *Wrightia tinctoria* bark shows wound healing in rats. In this study Methanol extract of *Wrightia tinctoria* was examined for its wound healing activity in the form of an ointment in two types of wound model in rats: (i) the excision wound model and (ii) the incision wound model. Experimental study reported the wound healing activity of herbal ointment containing *wrightia tinctoria* leaf extract. The herbal ointment containing *wrightia tinctoria* leaf extract showed potent wound healing activity on guinea pig model with incision and excision wound.

6.2 Antinociceptive activity²⁵

Experimental study reported the antinociceptive activity of *Wrightia tinctoria* bark. The ethyl acetate, acetone and methanol extracts of *Wrightia tinctoria* bark showed antinociceptive activity on acetic acid-induced writhing test in mice, their effects being comparable to that of acetylsalicylic acid. Experimental study reported the effect of hydroalcoholic extract of *Wrightia tinctoria* bark on antinociceptive activity in rats and mice. In this study hydroalcoholic extract of *Wrightia tinctoria* was examined for its antinociceptive activity on phenobarbitone induce hypnosis.

6.3 Anti- anxiety activity²⁶

Experimental study reported the Effect of *Wrightia tinctoria* on anxiety patterns in rats. Experimental study reported the Effect of *Wrightia tinctoria* on the brain monoamines and metabolites in rats. The effect of acute administration of *Wrightia tinctoria* (Wt) (leaves) methanolic extractives, constituting indigotin (HPTLC, relative abundance 21.97 %), indirubin (27.13 %), tryptanthrin (21 %), isatin (2.70 %) and rutin (14.24 %), was studied on the rat brain concentrations of monoamines and their metabolites in five different brain regions, viz. hypothalamus, hippocampus, striatum, pons medulla and frontal cortex.

6.4 Antidandruff Activity²⁷⁻²⁸

Experimental study reported the Dano: an herbal solution for dandruff from bark of *Wrightia tinctoria*. Dano, poly-herbal hair oil was studied for anti-dandruff activity using microbiological and clinical tests. There was a clear symptomatic relief from dandruff in all the volunteers after 10 days of use. Further, the isolation of *Pityrosporum ovale*, the causative organism of the dandruff in culture was not possible after use of the Dano oil. The plant extracts is from *Wrightia tinctoria* (Indrajiv), *Cassia alata* (Dadmari) and bitter fraction of *Azadirachta indica* (Neem or Nimba). Methylene blue reductase test was employed to study the anti-dandruff efficacy of the oil.

6.5 Antiulcer activity²⁹⁻³⁰

Experimental study reported the Evaluation of the antiulcer activity of *Wrightia tinctoria* bark extract in induced acute gastric ulcers in rat. In this study the hepatoprotective effect of triterpene fraction isolated from the stem bark of *Wrightia tinctoria* (containing lupeol, -amyrin and -sitosterol) on CCl₄-induced hepatotoxicity in the rat. CCl₄ (1.5 mg/kg, i.p) is a potent hepatotoxic agent which causes peroxidative degeneration of membrane lipids with the potential outcome of fatty degeneration has been found.

Experimental study reported the antiulcer effect of ethanolic extract of *Wrightia tinctoria* leaves on albino rats. The ethanolic extract of *Wrightia tinctoria* leaves showed antiulcer activity on aspirin plus pylorus ligation induced ulcer model.

6.6 Postcoital interceptive activity³¹

Experimental study reported the Postcoital interceptive activity of *Wrightia tinctoria* in Sprague–Dawley rats: a preliminary study The ethanolic extract of the stem bark and its serial fractions were administered to female rats on Days 1–7 or 1–5 postcoitum (Day 1: day of sperm-positive vaginal smear) by the oral route. At autopsy on Day 10 postcoitum, the number and status of corpora lutea and implantations were recorded. For estrogen-agonistic activity, immature rats ovariectomized 7 days earlier received the test extract or the vehicle once daily for 3 days and, at autopsy on Day 4, uterine weight, status of vaginal opening and extent of vaginal cornification were recorded.

6.7 Immunomodulatory Activities³²

Experimental study reported the Immunomodulatory Activities of *Wrightia tinctoria* (Roxb.) R. Br Bark Extracts. *Wrightia tinctoria* (Roxb.) has been reported to exhibit number

of therapeutic uses such as astringent, stomachic, febrifuge, skin diseases and tonic in India. The objective of the present study was to investigate the immunomodulatory activity of the bark extracts of *Wrightia tinctoria* using delayed type hypersensitivity reaction and carbon clearance assay.

6.8 Anti-diuretic activity³³⁻³⁴

Experimental study reported the diuretic activity of aqueous and alcoholic extracts of *Wrightia tinctoria*. Water and alcoholic extract of leaves of *Wrightia tinctoria* (apocyanaceae) were subjected to various phytochemical analysis to identify carbohydrates, phytosterols, tannins and lignin. Both the extracts were investigated for diuretic activity. Total urine volume and the concentration of sodium, potassium and chloride ions in the urine those parameters are taken into Account during the experimental work on each rat. The extracts showed a potent diuretic effect with increase in electrolyte concentration in urine, when compared with standard drug (frusemide) in albino rats.

6.9 Antimicrobial activity³⁵⁻³⁷

Experimental study reported the effect of chloroform, ethanol and methanol extract of *Wrightia tinctoria* leaf on antimicrobial activity against human pathogenic bacterial strains *E.Coli*, *Bacillus Subtilis*, *Staphylococcus aureus* and *Pseudomonas*. In this study ethanolic extract showed higher inhibition zone on different pathogenic strains.

6.10 Anthelmintic activity³⁸⁻⁴⁰

Experimental study reported the Anthelmintic activity of methanolic extract of *Wrightia tinctoria* leaves. The methanolic extract of *Wrightia tinctoria* leaves showed potent Anthelmintic activity using adult earthworms and piperazine citrate as standard.

6.11 Anti HIV and cytotoxic activity⁴¹⁻⁴³

Experimental study reported the anti HIV and cytotoxic activity of different solvent extract of *wrightia tomentosa* leaves. The different solvent extract of *wrightia tomentosa* leaves showed potent anti HIV and cytotoxic activity on mock infected MT-4 cells. Experimental study reported the cytotoxic, antioxidant and antimicrobial activity of ethanol extract of *Wrightia tinctoria* flower. The ethanolic extract of *Wrightia tinctoria* flower showed potent antioxidant activity on DPPH free radicals, potent antibacterial activity on bacterial strains like *staphylococcus aureus* and potent cytotoxic activity.

6.12 Hepatoprotective Activity⁴⁴

Experimental study reported the Hepatoprotective Activity of chloroform extract of *Wrightia tinctoria* leaves. The chloroform extract of *Wrightia tinctoria* leaves showed the potent hepatoprotective activity on CCl₄ induced hepatotoxicity in human liver derived change liver cell.

6.13 Anti inflammatory activity⁴⁵⁻⁴⁶

Experimental study reported Anti-inflammatory Study of *Wrightia tinctoria* R.Br Stem Bark in Experimental Animal Models. In the present study, the bark of *Wrightia tinctoria* was investigated for anti-inflammatory activity by carrageenan-induced rat paw oedema and cotton pellet induced granuloma method. The various extracts showed inhibition of rat paw oedema and percent granuloma changes at dose of 200mg/kg when compared to control group. The activity was compared with that of standard drug diclofenac sodium (13.5 mg/kg /b w, p.o).

Experimental study reported the antiinflammatory activity of ethyl alcohol and aqueous extract of *Wrightia tinctoria* leaves. The ethyl alcohol and aqueous extract of *Wrightia tinctoria* leaves showed the potent antiinflammatory activity on hypototoxicity induced HRBC membrane.

6.14 Antiviral activity⁴⁷

Experimental study reported the antiviral activity of chloroform extract of *Wrightia tinctoria* and *Morinda citrifolia* leaves and fruit powder respectively. The chloroform extract of *Wrightia tinctoria* and *Morinda citrifolia* showed the potent antiviral activity against cytopathic effect of HIV-1 (III B) in MT-4 cells.

6.15 Anti psoriatic Activity⁴⁸

Experimental study reported the Antipsoriatic Activity of ethanol extract of *Wrightia tinctoria* leaves. The ethanol extract of *Wrightia tinctoria* leaves showed the potent antipsoriatic activity on diphenyl picryl hydrazyl radical, nitric acid radicals and hydrogen peroxide radicals.

6.16 Antimicrobial activity⁴⁹

Experimental study reported the in vitro screening of antimicrobial activity of methanol extract of *Wrightia tinctoria* leaves. The methanol extract of *wrightia tinctoria* leaves showed potent antimicrobial activity against different microbial strains

like staphylococcus aureus, E.coli, Proteus vulgaris, proteus mirabilis.

Experimental study reported the antibacterial activity and phytochemical screening of hexane, methanol, chloroform, ethyl acetate extract of wrightia tinctoria leaves. The different extracts of Wrightia tinctoria leaves showed the potent antibacterial properties against plant pathogenic bacteria.

7. CONCLUSION

This review shows that *Wrightia tinctoria* is an important medicinal plant with diverse pharmacological spectrum. Few novel chemical constituent isolated from the *Wrightia tinctoria* showed anti-cancer, anti-HIV, and anti-ulcer properties too. Further evaluation need to be carried out on *Wrightia tinctoria* in order to explore concealed areas and their practical clinical application, which can be used for the welfare of the mankind port in carrying out this study at the laboratory.

REFERENCES

- Mahendra S. Khyade, Nityanand P. Vaikos. Pharmacognostical and Physio-Chemical Standardization of Leaves of *Wrightia Tinctoria* R.Br. 2009; 1(8):1-10.
- Mahendra S. Khyade, Nityanand P. Vaikos. Comparative phytochemical and antibacterial studies on the bark of *Wrightia tinctoria* and *Wrightia arborea*. International journal of Pharma and biosciences 2011; 2: 176-18.
- Mahendra S. Khyade, Nityanand P. Vaikos. Pharmacognostical and Physio-Chemical Standardization of Leaves of *Wrightia Tinctoria* R.Br. International Journal of Pharma Research and Development. 2005; 8:1-10.
- Y. S. R Reddy, S. Venkatesh, T. Ravichandran, T. Subburaju, B. Suresh. Pharmacognostical studies on *Wrightia tinctoria* bark, Pharmaceutical Biology. 1999; 37 (4): 291--295.
- S.G. Joshi. Medicinal plants. 4th ed. Oxford and IBH publishing Co. Pvt. Ltd., New Delhi (2000) 51-52.
- A.K. Nadkarni. Indian Materia Medica. 6th ed. Popular Prakashan. Bombay(1976)
- P.S. Varier. Indian Medicinal plants. Vol. I-V. Orient Longman Ltd. Madras (1997).
- M.J. Kothari, A.N. Londhe, Ethnobotany of Human Healthcare of Chikhaldara, Amravati District in Maharashtra State.: In J.K. Maheshwari Ed.: Ethnobotany and medicinal plants of Indian subcontinent, Scientific Publishers, Jodhpur, India. 2000.
- D Ghosh, P Thejmoorth, G. Veluchamy. Anti inflammatory, analgesic and antipyretic activities of 777 oil-a siddha medicine. Bull. Med. Ethnobot. Res. 1985; 6(2-4): 141-154.
- J.R. Krishnamurthi, S. Kalaimani, G. Veluchamy. Clinical study of Vetapalai (*Wrightia tinctoria*) oil in the treatment of Kalanjagapadai (Psoriasis). Journal of Res. Ayurveda & Siddha.1981; 2(1): 58-66.
- M. Daniel, S.D. Sabnis. Chemo taxonomical studies on Apocynaceae. Indian J. Exp. Biol. 1978; 16(4): 512-513.
- M. Daniel, S.D. Sabnis. A chemotaxonomic appraisal of the status of Apocynaceae and Asclepiadaceae. Indian Bot. Reporter. 1982; 1(2): 84-90.
- Mahendra S. Khyade, Nityanand P. Vaikos. Pharmacognostical and Physio-Chemical Standardization of Leaves of *Wrightia Tinctoria* R.Br. International Journal of Pharma Research & Development. 2005; 8:1-10.
- K.M.Nadkarni. Indian Materia Medica,3.1954;1:1296
- S. Rangaswami, M.Nageswara Rao. Crystalline chemical components of the bark of *Wrightia tinctoria* R. Br. Proceedings of the Indian Academy of Sciences. 1992; 57 (2): 115-120.
- http://medplants.blogpost.in/2012/07/Wrightia_tinctoria-dudhi-tella-papa.html
- www.worldagroforestry.org
- M. Nageswara Rao, E. Venkata Rao, V. Subba Rao. Occurrence oleanolic acid in the pods of *Wrightia tinctoria*. Current Science. 1968; 37:645
- M.A. Iyengar, S.G.K. Nayak. Anatomy of crude drugs, college of Pharmaceutical sciences, K.M.C., Manipal.
- T.E. Wallis. Text Book of pharmacognosy, 5th ed. CBS Publisher and Distributors. Delhi (1967).
- P.Malvia. Pharmacognostical investigation of seeds of *Wrightia tinctoria* and *Holarrhena Antidysenterica* Wall. Indian Journal of Pharmaceutical Education, 1975; 9(1): 25.

- 22 C.I. Jolly, N.R. Mechery. Pharmacognostical, physicochemical and antibacterial studies on seeds of *Holarrhena antidysenterica* Wall and *Wrightia tinctoria* R. Br. Indian J Pharm. Sci. 1996; 58:51-4.
- 23 V.P. Veerapur, M.B. Palkar, H. Srinivasa, M.S. Kumar, S. Patra, P.G.M. Rao. The effect of ethanol extract of *Wrightia tinctoria* bark on wound healing in rats. Journal of Natural Remedies 2004; 4(2):155-159.
- 24 M.C. Divakar, S. Lakshmi Devi. Wound Healing Activity of the leaves of *Wrightia tinctoria*. Indian Drug, 2012; 49(3):40-46.
- 25 Y.S.R. Reddy, S. Venkatesh, T. Ravichandran, V. Murugan, B. Suresh. Antinociceptive activity of *Wrightia tinctoria* bark. Fitoterapia. 2000; 73: 421-3.
- 26 A.V. Muruganandam, A. K. Jaiswal, S. K. Bhattacharya, S. Ghosal. Effect of *Wrightia tinctoria* bark on anxiety patterns in rats, Indian Journal of Pharmacology. 1998; 30(2): 124.
- 27 J. R. Krishnamoorthy, S. Ranganathan, S. Gokul Shankar, M.S. Ranjith. Dano: an herbal solution for dandruff. African Journal of Biotechnology, 2006; 5(10): 960—962.
- 28 S.P. Dhanabal, B.A. Raj, N. Muruganantham, T.K. Praveen, P.S. Raghu. Screening of *Wrightia tinctoria* leaves for anti psoriatic activity. Hygeia 2012; 4 :73-8.
- 29 P. Bigoniya, A.C. Rana, G.P. Agrawal. Evaluation of the antiulcer activity of *Wrightia tinctoria* bark extract in induced acute gastric ulcers in rat. Nigerian Journal of Natural Products and Medicine. 2006; 10: 36-40.
- 30 M.C. Divakar, S. Lakshmi Devi. Antiulcer activity of *Wrightia tinctoria* (Roxb) R.Br. Der Pharmacia Sinica. 2011; 2 (2): 355-360.
- 31 G. Keshri, S. Kumar, D.K. Kulshreshtha, S.M. Rajendran, M.M. Singh. Postcoital interceptive activity of *Wrightia tinctoria* in Sprague-Dawley rats: A preliminary study. Contraception 2008; 78: 266-70.
- 32 S.Sathianarayanan, A.Rajasekaran, Immunomodulatory activity of ethanolic extract of *wrightia tinctoria*, Int journal of pharmacy and pharmaceutical science; 4(4):251-254.
- 33 S. Sathianarayanan et al. diuretic activity of aqueous and alcoholic extracts of *Wrightia tinctoria*. International journal of phytopharmacology. 2011; 2(1):7-8.
- 34 P. Vedhanarayann, P. Unnikannan, P.Sundaramoorthy, Antimicrobial activity and phytochemical screening of *Wrightia tinctoria* (Roxb.) R.Br. Journal of Pharmacognosy and Phytochemistry. 2013; 2 (4): 123-125.
- 35 H.S. Nagalakshmi, A. Das, S. Bhattacharya. In vitro antimicrobial properties and phytochemical evaluation of mature seed extracts of *Wrightia tinctoria* R. Br. J Pure Appl Microbiol. 2012; 6 :1273-9.
- 36 K. Moorthy et al. In vitro screening of antimicrobial activity of *Wrightia tinctoria* (roxb.) R. Br. Asian J Pharm Clin Res. 2012; 5(4):54-58.
- 37 S.sridhar. Studies on antimicrobial activity, physio-chemical and phytochemical analysis of *Wrightia tinctoria* R.Br. ijprd. 2011; 3(8): 139 – 144.
- 38 G.R. Rajalakshmi et al. In vitro anthelmintic activity of *Wrightia tinctoria*. International Journal of Pharma tech res. 2013; 5:2.
- 39 S. Sathinarayanan et al. Anthelmintic activity of methanolic extract of *Wrightia tinctoria* leaves. International journal of biological & pharmaceutical research. 2012; 3(5): 697-698.
- 40 Shruthi, K. P. Latha, H. M Vagdevi, V. P. Vaidya, B. Pushpa, C. Shwetha. In vitro Anthelmintic Activity of Leaves Extract of *Wrightia tinctoria*, International Journal of Chem Tech Research. 2010; 2 (4): 2043.
- 41 P. Selvam, N. Murgesh et al. Studies of antiviral activity and cytotoxicity of *Wrightia tinctoria* and *Morinda citrifolia*. Indian J Pharm Sci. 2009; 71(6): 670–672.
- 42 S. Sathyanarayanan et al. Preliminary phytochemical screening and Study of antiviral activity and cytotoxicity of *Wrightia tinctoria*, Int. J. Chem. Sci.: 7(1), 2009, 1-5.
- 43 P.Selvam, E De Clercq. Studies on Anti HIV activity and cytotoxicity of *Wrightia tomentosa* leaf. International journal of pharmacy and analytical research. 2012, 1(1):8-11.
- 44 P. Bigoniya, A.C.Rana, G.P. Agrawal. Evaluation of the antiulcer activity of *Wrightia tinctoria* bark extract in induced acute gastric ulcers in rat. Nigerian Journal of Natural Products and Medicine. 2006; 10: 36-40.

- 45 Sethuraman, V., M.G. Sethuraman, N. Sulochana and R.A. Nambi, Anti-inflammatory activity of *Wrightia Tinctoria* flowers, Indian Drugs 1984. 22: 158-159.
- 46 P. R. Tharkar et al. Anti-inflammatory Study of *Wrightia tinctoria* R.Br Stem Bark in Experimental Animal Models. International Journal of PharmTech Research. 2010;2(4):2434-2437.
- 47 Sathyanarayanan S, Selvam P, Asha J, George RM, Revikumar KG, Neyts J. Preliminary phytochemical screening and study of antiviral activity and cytotoxicity of *Wrightia tinctoria*. Int J Chem Sci. 2009;7:1.
- 48 Fredrick manuel, Boopa R., Gomathy J.N., Efficacy of 777 oil (*Wrightia Tinctoria*) in the treatment of psoriasis, The antiseptic. 1997; 94(3):75-76.
- 49 Sridhar S, Kamalakannan P, Elamathi R, Deepa T, Kavitha R. Studies on antimicrobial activity, physio-chemical and phytochemical analysis of *Wrightia tinctoria*. Int J Pharm Res Dev. 2011; 3 (8):139-14.