Review Article

WRIGHTIA TINCTORIA(Roxb). R Br : AN UPDATED REVIEW

ABSTRACT

Plants are used medicinally in different countries and are a source of many potent and powerful drugs. Medical plants contain large varieties of chemical substances which possess important therapeutic properties that can be utilized in the treatment of human diseases. *Wrightia tinctoria* is a well-known potential medicinal plant distributed in tropical region belongs to the family Apocynaceae. The leaves of this plant are traditionally used in the treatment against Psoriasis and non-specific dermatitis in Siddha and Ayurvedic systems of medicine. This plant is good for treatment of dandruff, various scalp and skin disorders. Phytochemical and pharmacological investigation on the various parts of the plant showed anti-ulcer, anti-inflammatory, analgesic, anthelmintic, anti-cancer, anti-dandruff, wound healing and anti-anxiety activity. The current review focus on providing an update on the recent pharmacological and phytochemical investigations on the plant by researchers around the globe with special emphasis on Antisporiatic, Antifungal, Antibacterial, Antiviral, Cytotoxic, Anti-inflammatory, Anti-diabetic, Analgesic, Hepatoprotective, Anthelmintic, and Wound healing activities.

Keywords: [Wrightia tinctoria, Medicinal plant, pharmacology, phytochemistry}

1. INTRODUCTION

Wrightia tinctoria (Roxb) R.Br is a small deciduous tree, bark scaly smooth, young parts glabrous or puberulous. Leaves variable, 7.5-15 by 2.5-5.7cm, elliptic, lanceolate or oblong lanceolate, acuminate, glabrous or the young leaves puberulous beneath, base acute or rounded, main nerves 6-12 pairs, petioles 3-4mm long. Flowers white fragrant, in lax terminal cymes which are sometimes 12.5cm diameter with slender spreading dichrotomous branches; bracts minute, ovate, calyx glabrous glandular inside; segments 2.5mm long, oblong, rounded at the apex and with membranous margins. Corolla – tube short, 3mm long; obtuse; corona of numerous linear scales, some inserts with the filaments & some on the corolla lobes. Fruit of the two distinct pendulous follicles, 25-50cm by 6-8mm, cylindrical, slightly tapering to both ends, glabrous striate, cohering at first at the tip only. Seeds 1.3-2cm long pointed at the apex, with a deciduous coma often more than 3.8cm long at the base. Wrightia is named after a Scottish physician and botanist William Wright (1740 - 1827).

The intention of the current review is to explore different parameters of plant like general description, distribution microcopy, chemical constituents, traditional uses and to

highlight pharmacological activities studied in recent literatures. The search strategy adopted for this purpose focused on the databases like pubmed, scopus and web of science from inception to 2021.

Fig.1 *W. tinctoria* flowers and pods.

1.1 Plant Profile

Synonym : Sweet Indrajao, Pala indigo plant, Dyers's oleander, Dantappala, Vetpala

Kingdom : Plantae

Order : Gentianales

Family : Apocyanaceae

Genus : Wrightia

Species : tinctoria

Origin : India, Burma

1.2 Geographical distribution:

Rajputana, Central provinces, Deccan, Konkan, S.M Country, Circars, W. Ghats of Madras presidency, Ceylon, Burma-Tunor [1].

1.3 Seasons

Leaves fall in December or January, renewed in April- may. Flowering happens after the leaves, mid May to late June. Fruit conspicuous in November, ripens by the following summer [2].

1.4 Uses

The bark and the seeds of Wrightia tinctoria used in flatulence& bilious troubles. Seeds are aphrodisiac and anthelmintic. Arthritic fevers are cured by both from the leaves and bark. A decoction of the leaves and bark is taken as a stomachic. The dried and ground bark is rubbed over the body in dropsy. The fresh leaves are very pungent and are chewed for relief from tooth ache. Plant produces cream coloured latex; the coagulum may find use in code wire insulation, floor furnishing and adhesives where the rubber content of more than 10-13% is not required. Fresh latex is proteolytic and curdles milk. Bark is especially useful in piles, skin diseases and bilious troubles. Bark is used as tonic [3].

The name Nelempala (Malayalam script) is used as Nelem (From Neelem) means blue & pala refers to plants like 'Alstonia scholaris' that produces milky (pal means milk) latex. When the leaves of this plant is kept in a glass of coconut oil for a few hours, the oil slowly turns blue in colour (after 12-18 hours its colour becomes brown & ultimately black.) The name indicates this property of this species. This blue coloured oil is used as an effective medicinal against psoriasis [4].

Decoction of leaves and bark (1 in 10) in doses of ½ to 2 ounces, is used as stomachic, tonic and febrifuge, in combination with other vegetable bitters;given in bowel complaints and during convalescence from fevers and other acute diseases. Seeds are sweet and tonic and are given in seminal weakness [5].

2. PHARMACOLOGICAL ACTIVITY STUDIES

2.1 Antimicrobial activity

Wrightia tinctoria leaf hexane, methanol and ethanol extracts were screened against skin bacteria and dermatophytes by in vitro. The extracts were tested using agar dilution method and broth micro dilution method. Methanol and ethanol extracts showed antibacterial activity; the MIC was 0.5 mg/ml for Bacillus subtilis and Staphylococcus epidermidis; 0.25 mg/ml for Staphylococcus aureus. The hexane extract showed antifungal activity against Trichophyton rubrum and Trichophyton tonsurans at 2 mg/ml. The MIC of 2 mg/ml was observed for methanol extract against Trichophyton mentagrophytes and IC50 (2 mg/ml) was determined for Trichophyton rubrum and Epidermophyton floccosum [6].

N Al Zaqri et al synthesised zirconium oxide nanoparticles using Wrightia tinctoria leaf extract. ZrO2- NPs were synthesized by green synthesis method. XRD spectra analysis and DLS revealed the confirmation of the ZrO2-NPs. Zeta potential revealed that the well stabilized ZrO2-NPs. Biosynthesized ZrO2-NPs exhibited 94% degradation for RY 160 dye. Excellent antibacterial activities shown by biosynthesized ZrO2-NPs using Wrightia tinctoria leaf extract [7].

2.2 Antiulcer activity

The antiulcer activity of the Wrightia tinctoria methanolic extract (TM) and Wrightia tinctoria 70% ethanolic extract (T70E) were compared with carboxy methyl cellulose (CMC), pylorus control, Aspirin and standard famotidine which was evaluated by employing aspirin plus pylorus ligation induced ulcer model. The results of the study proved that the crude extract of Wrightia tinctoria possess antiulcer activity against experimentally induced acute gastric ulcer model [8].

2.3 Anticancer activity

The anticancer property of the leaves of Wrightia tinctoria were studied on HeLa Cells. The anti-cytotoxic effect of methanolic extract was evaluated in-vitro by employing MTT assay. The potency of each plant extract concentration was calculated in terms of percent decrease in viable HeLa cells as compared to the control value. The extract showed dose dependent anticancer activity. The MTT assay showed an antiproliferative activity (IC50) at 76.1 µg/ml of crude extract [19].

2.4 Antiinflammatory activity

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) [10].

The dried leaves of wrightia tinctoria were investigated for anti-inflammatory effects by HRBC membrane stabilization method and carrageenan induced hind paw edema method. Ethyl acetate fraction showed 67.21 % protection at a concentration of 400 mg/kg by the in vivo studies. The ethyl acetate fraction was studied for its analgesic effect on acetic acid-induced writhing test and hot plate method in mice and was found to be effective [11].

2.5 Antidiabetic activity

AK Shukla and Papiya Bigoniya studied the effect of total flavonoid isolated from W. tinctoria seed on alloxan induced diabetic model by assessing body weight change, relative organ weight, BG level, and serum lipid parameters. The effect of W. tinctoria seed flavonoid fraction was not significant on hyperglycemia and other disturbed biochemical parameter induced by alloxan, but it has significant effect on normalization of serum creatinine level and lowering of TG and relative weight of liver indicating possible presence of kidney and liver protective property.[12]

R Asok Raj et al reported hypoglycaemic activity in petroleum ether extract of Wrightia tinctoria in Alloxan-induced diabetic rats. The maximum reduction (74.39%) in serum glucose levels was seen in PWT at the dose of 400 mg/kg . The hypoglycemic effect of PWT may be its effect on potentiating the insulin activity either by increasing the pancreatic secretion of insulin from cells of islets of langerhans or its release from bound insulin[13].

2.6. Antifungal activity

The study was designed to investigate the in vitro antifungal activity of the pure compound indirubin isolated from Wrightia tinctoria. Wrightia tinctoria showed promising activity against dermatophytic and non-dermatophytic fungi. Leaf chloroform extract showed activity at 0.5 mg/ml against Trichophyton rubrum, Epidermophyton floccosum, Aspergillus niger and Scopulariopsis brevicaulis. Indirubin, exhibited activity against dermatophytes such as Epidermophyton floccosum , Trichophyton rubrum and Trichophyton tonsurans ; Trichophyton mentagrophytes and Trichophyton simii. It was also active against non-dermatophytes (Aspergillus niger, Candida albicans and Cryptococcus sp.)[14]

2.7. Wound healing activity

Excision wound model in mice was used to evaluate the healing potential of Wrightia tinctoria latex protease . Neosporin, a standard drug, was used for comparison. The progression of healing was monitored using physical (wound contraction), biochemical (collagen content, catalase and MMP activity) and histological examinations. Histological analysis on day 9 confirmed complete epithelialisation, re-establishment of skin structure and accelerated wound healing following WTLP treatment.[15]

2.8. Antipsoriatic activity

Wrightia tinctoria extract was evaluated for antipsoriatic activity by the mouse tail test for psoriasis. Longitudinal histological sections were prepared from the tail skin and stained with hematoxylineosin. The specimens were histometrically analyzed. The extract has shown potent activity (63.94%) than the standard isoretinoic acid (48.52%). Both the standard and sample increased the epidermal thickness compared to control in the mouse tail test.[16]

2.9. Post coital interceptive activity

The ethanolic extract of the stem bark of W. tinctoria R.Br. inhibited pregnancy in 100% of rats when administered orally at a 250-mg/kg dose on Days 1–7 or 1–5 postcoitum. On fractionation, the hexane-soluble, chloroform-soluble, water-soluble and water-insoluble fractions showed 100% anti-implantation effect, while n-butanol-soluble fraction intercepted pregnancy in 75% of animals when administered in the Days 1–5 postcoitum schedule. In immature rat bioassay, the active ethanolic extract and its fractions exhibited moderate to potent estrogen-agonistic activity, which might be responsible for their contraceptive action in this species.[17]

2.10. Antioxidant activity

The antioxidant activity of Wrightia tinctoria was evaluated in terms of free radical scavenging (DPPH and ABTS) and reducing power abilities (fluorescence recovery after photobleaching [FRAP] and TAC) of plant extracts. Results demonstrated that extracts exhibited significantly higher antioxidant activity than other antioxidant-rich medicinal plants . For DPPH and TAC, Wrightia tinctoria extract was effective (IC50 45.4 µg/ml and 50 mg

GAE/g, respectively). In ABTS Wrightia tinctoria showed IC50 31.7 µg/ml and FRAP 2.5 mMol Fe+2/g. [18]

S Ramalakshmi et al studied the antioxidant activity of flower extract of Wrightia tinctoria. The (IC50) of the flower extract was said to be 43.16µg/mL by 2,2-Diphenyl-1-Picrylhydrazyl method and 124.07 mg AAE/100g of plant extract by phosphomolybednum method[19].

2.11. Anthelmintic activity

Crude petroleum ether and chloroform extracts of leaves of Wrightia tinctoria were studied for anthelmintic activity using Pheretima posthuma. Three concentrations (2.5, 5.0, 7.5 mg/ml) of each extracts were studied in the activity, which involved the determination of time of paralysis and time of death of the worms. Piperazine citrate is used as standard reference and normal saline as control. It proved the potential usefulness of leaves of Wrightia tinctoria as comparable anthelmintic agent.[20]

2.12. Antinociceptive activity

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.[21] P Bigoniya et al reported antinociceptive effects in ethanolic bark extract of Wrightia tinctoria in normal rats when given orally. The antinociceptie effect of the extract was dose-dependent. Study revealed moderate analgesic effect against thermal and chemical noxious stimuli, but such action was not observed against the mechanical stimulus at the doses used[22].

2.13. Hepatoprotective activity

Triterpene fraction isolated from the stem bark of Wrightia tinctoria (containing lupeol, b –amyrin and b –sitosterol) was studied on CCl 4 –induced hepatotoxicity in the rat. The hepatoprotection of triterpene is compared with silymarin, a well known standard hepatoprotectant. Pretreatment with triterpene fraction (125, 250 and 400 mg/kg, p.o. once a day for 4 days before CCl 4 and continued further 3 days. Attenuated the CCl 4 –induced acute increase in serum SGPT, SGOT and ALP activities and considerably reduced the histopathological alterations. Further, triterpene fraction reduced thiopentone-induced sleeping time, suggesting the protection of liver metabolizing enzymes.[23]

NV Patil et al reported hepatoprotective activity of various extract of leave of Wrightia tinctoria against carbon tetrachloride induced toxicity in rats. The rats were sacrificed under the influence of mild ether anesthesia, biochemical study like SGOT, SGPT, ALP, bilirubin etc were carried. All three extracts found to have a hepatoprotective activity but methanolic extract showed maximum activity whereas aqueous extract showed the minimum activity[24].

2.14. Antiviral activity

Extracts of Wrightia tinctoria was tested for it's inhibitory effects against the replication of HIV-1(IIIB) in MT-4 cells. Inhibitory effect of extracts on HIV-1 replication was monitored by inhibition of virus-induced cytopathic effect in MT-4 cells and was estimated by MTT assay. Briefly, 50 µl of HIV-1(100-300 CCID50) were added to a flat-bottomed microtiter tray with 50 µl of medium containing various concentrations of extracts of WT. MT-4 cells were added at a final concentration of 6×105 cells/ml. After 5 days of incubation at 37°, the number of viable cells were determined by the 3-(4,5-dimethylthiazol-2-yl)-2,5-diphenyl tetrazolium bromide (MTT) method. Cytotoxicity of WT against mock-infected MT-4 cells was also assessed by the MTT method.

The different extracts of WT have been evaluated for anti HIV activity in acutely infected MT-4 cells. None of the extracts exhibited anti HIV activity in acutely infected MT-4 cells. CWT exhibited a maximum protection of 48% of the MT-4 cells against the cytopathic effect of HIV-1(IIIB) at subtoxic concentration. However the MWT showed some cytotoxic activity in lymphocyte (MT-4) cells (CC50: 44.8 µg/ml). [25]

2.15. Immunomodulatory activity

The effect of the methanolic extract of the leaves of Wrightia tinctoria on the primary and secondary antibody responses was evaluated by the humoral antibody response for a specific immune response. The effect of Wrightia tinctoria on the neutrophil activation was evaluated by the neutrophil adhesion test for a nonspecific immune response. The data was analyzed by one-way ANOVA followed by Duncan's multiple range test/unit. On oral administration, Wrightia tinctoria showed a significant increase in the primary and secondary humoral antibody responses, by increasing the hemagglutinating antibody titre at doses of 100 and 200mg/kg/bw. There was a significant increase in the percentage neutrophil adhesion at doses of 200mg/kg/bw. Also Wrightia tinctoria – possesses significant delayed hypersensitivity response in the increasing doses showing the greater activity in the dose of 200mg/kg/bw. The serum immunoglobulin test evoked a significant rise in the ethanolic extract of the leaves of the plant Wrightia tinctoria by increasing doses and shows maximum at 200mg/kg/bw.[26]

2.16. Absence of central activity

P Bigoniya and AC Rana studied central activity profile of Wrightia tinctoria. W. tinctoria ethanolic extract did not have any significant effect on pentobarbitone-induced hypnosis. The extract is devoid of any protective effect against leptazole- or MES-induced convulsions at any of the tested doses[27].

2.17. Antispasmodic and antidiarrhoeal activity

P Bigoniya et al isolated steroidal alkaloid from Wrightia tinctoria bark ethanol extract and investigated on different experimentally induced diarrhoea models of rats, isolated rat ileum, and on enteric bacterium to establish the therapeutic potential. The extract at 500 and 1000 mg/kg dose, and WTSA at 50 and 100 mg/kg dose significantly inhibited the frequency and wetness of faecal droppings in castor oil-induced diarrhea. Extract and WTSA decreased propulsion of charcoal meal and also reduced prostaglandin E2-induced enteropooling.

WTSA reduced amplitude, frequency, and tone of spontaneous gut movement. Alkaloid fraction also inhibited acetylcholine (Ach)- induced contraction of rat ileum[28].

2.18. Larvicidal activity

M Sakthivadivel et al reported the larvicidal activity of crude aqueous and petroleum ether extracts of Wrightia tinctoria fruits and leaves against the filarial vector, Culex quinquefasciatus. The larvicidal activity was evaluated at concentrations of 0.06%, 0.12%, 0.25%, 0.50% and 1.00%. Larval mortality was observed for 24 and 48 h. Among the plant parts tested, aqueous fruit extract exhibited highest larvicidal activity followed by aqueous leaf extract with LC50 values of 0.17% and 0.09%; 0.21% and 0.11% after 24 and 48 h respectively[29].

Table 1: Pharmacological activities of various parts of *W.tinctoria.*

Activity studied	Plant parts used	References
Antisporiatic activity	leaves	SP Dhanabal et al [30]
Antifungal	leaf	K ponnusamy et al [15]
Antifungal	leaf	KV Devika et al [31]
Antibacterial and antifungal	leaf	M Rajani et al [32]
Antibacterial	leaf	P Kannan et al [7]
Antibacterial	leaf	K Moorthy et al [33]
Antibacterial	bark	MS Kyade et al [34]
Antibacterial	leaf	S Sridhar [35]
Antibacterial	leaf	S Ravisankar et al [36]
Cytotoxic	Stem bark	Chaudhary S et al [37]
Cytotoxic	Flowers	S Ramalakshmi et al [38]
Cytotoxic	Leaves	Sophiya R et al [39]
Anti-inflammatory	Stem bark	Tharkar et al., 2010 [11]
Anti-inflammatory	Stem bark	Jain and Bari, 2010 [40]
Anti-inflammatory	Leaf	Aleykutty et al., 2011[12]
Anti-inflammatory	Leaf	Rajalakshmi and Harindran [41]
Anti-diabetic	Leaf	RA Raj et al, 2010 [14]
Anti-diabetic	leaf	Rajani Srivastava [42]

Anti-diabetic	Pods	MS Rani et al [43]
Analgesic	leaf	Aleykutty et al., 2011[12]
Analgesic	Stem ark	Reddy et al., 2002 [22]
Hepatoprotective	Stem bark	Bigoniya and Rana, 2010 [24]
Hepatoprotective	Seed and leaves	H Jamshed et al [19]
Helmintholytic	leaf	SR Dore et al [44]
Anthelmintic	leaf	A Sruthi et al [21]
Anthelmintic	leaf	GR Rajalakshmi et al [45]
Wound healing	latex	M Yariswami et al [16]
Wound healing	latex	VP Veerapur et al [46]

3. PHYTOCHEMISTRY

Pods without seeds contains the cycloartanes, cycloartenone, and cycloeucalenol along with alpha and beta amyrin, betasitosterol, ursolic acid, oleanolic acid and the terpene wrightial. The leaves contain beta amyrin. Stem bark beta- amyrin, beta sitosterol and lupeol [47].

3.1 Phytochemical studies

Preliminary phytochemical analysis of methanolic extract of Wrightia tinctoria showed the presence of alkaloids and flavones. The instrumental analysis of mathanolic extract of Wrightia tinctoria was carried out using various analytical techniques such as UV, TLC and HPLC, which showed the presence of indole derivatives such as isatin and indurubine . Fixed oils such as myristic acid, palmitoleic acid and behenic acid were identified by using GC. [48]

The results of the phytochemical screening of the bark of Wrightia tictoria indicates the presence of alkaloids, phenolics, saponins, tannins terpenoids, steroids, triterpenoids, flavonoids and carbohydrates. [49]

Similarly S Sridhar et al reported the presence of carbohydrates, alkaloids, steroids, phenols, saponins, tannins, flavonoids and proteins in the leaves of Wrightia tinctoria. [36]

A study conducted by SR Sankar et al on leaves indicated the presence of alkaloids, terpenoids, glycosides, flavanoids, saponins and phlobatannins.[37]

In another study Indigotin , indirubin , tryptanthrin , isatin , anthranillate and rutin have been isolated and identified as major constituents of Wrightia tinctoria. The identities of these compounds have been established by comprehensive chromatographic (HPTLC, HPLC) and spectroscopic (UV-VIS, IR, EI-MS) techniques, using markers and by synthesis,

where possible. While indigotin is found to be native in the living plants (in fresh leaves), indirubin was found to be an artifact formed only during drying process after harvesting of the leaves. This transformation is presumably caused by the intact hydrolytic enzyme system(s) and by autoxidation. Seasonal variation studies of the chemical constituents of leaves, using HPTLC and HPLC analyses, revealed that concentration of indigotin-indirubin combination steadily increases from August to November. In contrast, concentration of isatin and anthranillate increases in the months of December and January, at the expense of indigotin-indirubin. Isatin is produced by the autoxidation of indigotin. Tryptanthrin concentration also increases, periodically, in May (at the expense of isatin) and in January. [50]

Along with the phytocompounds, W.tinctoria is also found to contain important enzyme. Proteases are commercially important class of enzymes and the hydrolytic property of the enzyme is exploited in various biotechnological processes. A serine protease, Wrightin, has been isolated from the latex of Wrightia tinctoria. The stable thermodynamic properties of Wrightin make it an economical source of protease for commercial exploitation.The plant contains Wrightial, a triterpenoid chemical, along with Cycloartenone, Cycloeucalenol, βamyrin and β-sitosterol as phytocompounds [51].

A new sterol isolated from the unsaponifiable lipid of Wrightia tinctoria seed and was shown to be 14α-methylzymosterol by comparison with a synthetic authentic compound. Four uncommon sterols, desmosterol, clerosterol, 24-methylene-25-methylcholesterol and 24-dehydropollinastanol were isolated and identified [52].

A Rajagopalan et al separated proteases from wrightia tinctoria bark and partially purified through a non-chromatographic technique, three phase partitioning (TPP), to concentrate the milk clotting proteases. Maximum recovery and purification fold of the protease activity were found in the interfacial phase (IP) with 60% ammonium sulphate and 1:1 crude enzyme to t-butanol. Optimum pH and temperature of the enzyme fraction were found to be 7.5 and 50 °C respectively. Inhibition studies revealed its serine nature. Non-denaturing PAGE, Zymography and 2D PAGE of IP revealed presence of three different caseinolytic proteases of molecular weights 95.62 kDa, 91.11 kDa and 83.23 kDa with pI 3.89, 5.45 and 5.43 respectively. Both aqueous and lyophilized form of IP were remarkably stable retaining complete activity at 4 °C for 3 weeks[53].

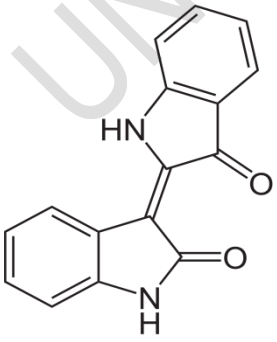

Fig 2: Structure of Indirubin

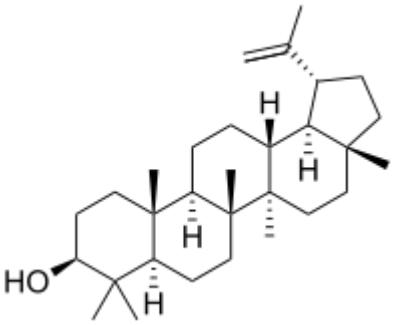

Fig 3: Structure of lupeol

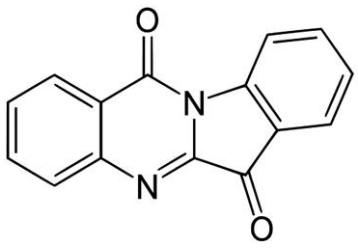

Fig 4: Structure of Tryptathrin

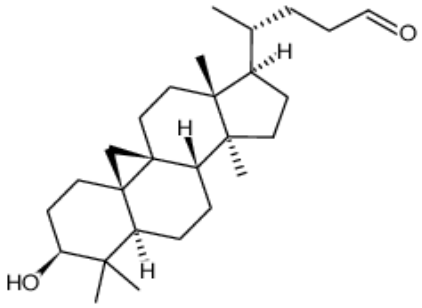

Fig 5: Structure of Wrightial

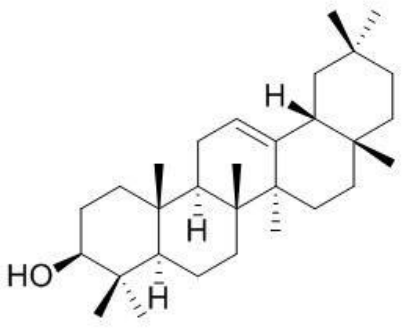

Fig 6: Structure of Beta amyrin

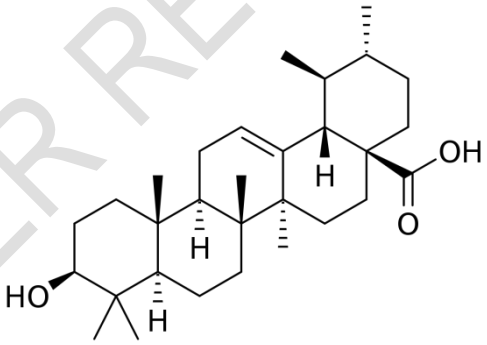

Fig 7: Structure of Ursolic acid

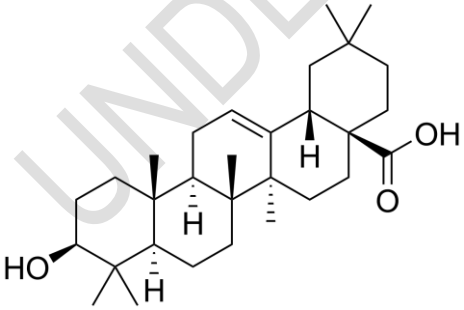

Fig 8: Structure of Oleanolic acid

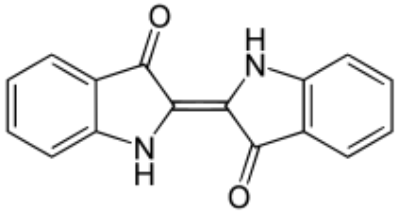

Fig 9: Structure of Indigotin

4. CONCLUSION

Wrightia tinctoria has been used in ayurvedic and siddha system of medicine for its effects against psoriasis and epidermal thickening and drying problems. It is added in hair oil preparations as it effectively minimises dandruff. The pharmacological studies proves its pharmacological significance such as antiviral, anti-inflammatory, cytotoxic, hepatoprotective, wound healing, post coital interceptive, anthelmintic, antinociceptive, antioxidant, antiviral, antifungal, antibacterial , antidandruff and antipsoriatic activity.Total flavonoid isolated from W. tinctoria seed lack hypoglycemic effect.

The presence of alkaloids, flavones, saponins, tannins, terpenoids, steroids, triterpenoids, carbohydrates, glycosides, Indole derivatives such as isatin and indurubine, fixed oils such as myristic acid, palmitoleic acid and behenic acid and indigoid compounds reflects its phytochemical abundance. So the present study suggests that the proved phytochemical and biological characteristics makes Wrightia tinctoria a promising drug to the pharmaceutical industries and a good candidate for more exploration to the future.

COMPETING INTERESTS DISCLAIMER:

Authors have declared that no competing interests exist. The products used for this research are commonly and predominantly use products in our area of research and country. There is absolutely no conflict of interest between the authors and producers of the products because we do not intend to use these products as an avenue for any litigation but for the advancement of knowledge. Also, the research was not funded by the producing company rather it was funded by personal efforts of the authors.

NOTE:

The study highlights the efficacy of " Ayurvedic" which is an ancient tradition, used in some parts of India. This ancient concept should be carefully evaluated in the light of modern medical science and can be utilized partially if found suitable.

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