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A COMPLETE REVIEW OF OLDENLANDIA UMBELLATA LINN (IMPURAL) PLANT

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ABSTRACT

Oldenlandia umbellata linn plant is very well known for its therapeutics benefits in Indian systems of medicine including Ayurveda and Siddha and in other forms of traditional medicine worldwide for the treatment of several ailments. The colouring matter is found principally in this plant and is collected when the plants was dried through some extraction methods. Our review article focusses to pharmacognostical studies and give number of pharmacological activites are Anti-Tussive, Cytotoxicity, Anti-Inflammatory, Anti-Pyretic, Hepatoprotective Effect, Antioxidant, Anti-Bacterial and Anti-Microbial activity and also against Respiratory Tract Pathogens. This article can give potential research areas to explore next, and to formulate new formulation in allopathy and some traditional medicine system.

KEYWORDS: Oldenlandia umbellate, Anti-Tussive, Chaaya ver, Chay root, Anti-Microbial.

INTRODUCTION

Oldenlandia umbellata (called chay root or choy root, from its Tamil name, chaaya ver) is a low-growing plant native to India. A colour-fast red dye can be extracted from the root bark of (preferably) a two-year-old plant. Chay root dye was once used with a mordant to impart a

red colour to fabrics such as calico, wool, and silk. It is grown on the Coromandel Coast in India.[1]

Kingdom	Plantae
Clade	Tracheophytes
Clade	Angiosperms
Clade	Eudicots
Clade	Asterids
Order	Gentianales
Family	Rubiaceae
Genus	Oldenlandia
Species	*O. umbellate*

The genus Oldenlandia, belonging to the family Rubiaceae, consists of different species, many of which are used in traditional medicine. *Oldenlandia umbellata* L., an ancient Indian herb, commonly known as ‘‘Indian madder’’, is known to yield red color pigmentation from its roots, and has been used in diverse applications since ancient times. The root bark, preferably of a two-year-old plant, when used with a mordant will confer red color to calico, wool, and silk fabrics. Both leaves and roots are also deemed good expectorants, and used for treatment of asthma, bronchitis, and bronchial catarrh. A decoction of leaves is used as a rinse to treat poisonous bites, and also reported as a novel pH indicator dye. These varied uses have increased utilization and exploitation of *O. umbellata* for medicinal and dye extraction purposes. Oldenlandia grows wild in forests, among other areas, and there is no propagation system available to replenish these stands.[2]

Pharmacognostical Studies

Reddy BM describes about the investigation, microscopic and macroscopic details of the stem and leaf of *Oldenlandia umbellata* have been studied. These characters like stem hairs, shape, arrangement, and size of leaf epidermal cells, stomata size, and stomatal index, presence of stomata only on the lower epidermis are useful to identify the crude herbal drug

of the plant. The present study revealed that the stem contains Flavonoids, Triterpenoids, Alkaloids, Carotenoids, Fatty acids, Tannins, Glycosides, Chlorogenic acid, Saponins, Gum, and Mucilage. Whereas, the leaf contains Flavonoids, Steroids, Alkaloids, Carotenoids, Fatty acids, Tannins, Glycosides, Saponins, Polyuronoids, Chlorogenic acid, Gum, and Mucilage. But the chemicals, Emodins, Anthrcene glycosides, Phlobatanins are absent in both stem and leaves. The chromo-fingerprints of stem and leaf are unique and very useful to identify the crude drug. It produces a bright fluorescent pattern. The color pattern of both stem and leaf in daylight and UV-254nm is identical with slight variation in the shade. But, the pattern in UV-365nm specifically in Methanol, Rectified spirit, Water, and HCl zone shows a clear difference between stem and leaf. It also helps in identifying the crude material and in determining the purity of the sample.[3]

1. GC- MS Analysis

Somnath De et al., describes about the study was to carry out Gas chromatography and Mass spectroscopy analysis of phytocomponents in the methanolic extract of *Oldenlandia umbellata*. The GC-MS analysis of *O. umbellata* powder extract with in methanol is performed using GC–MS equipment Thermo GC-TRACE ultra ver: 5.0, Thermo MS DSQ II. Experimental conditions of GC-MS system are as follows: DB 35 - MS capillary standard non - polar column, dimension: 30 Mts, ID: 0.25 mm, FILM: 0.25 µm is used and flow rate of mobile phase (carrier gas: He) is set at 1.0 ml/min. GC-MS chromatogram of methanolic extract of *O. umbellata* shows 22 peaks indicating the presence of twenty two compounds. GC-MS analysis reveal that the presence of 22 different phytochemical compounds namely Heptacosyl pentafluoropropionate - (17.34%), Cholestane 3,6,7triol, (3a,5a,6a,7a) - (2.54%), Methane, oxybis [dichloro - (1.09%), Dibutyl-phthalate-(0.16%), Phytol- (0.11%), Nonacosane-(0.11%). GC-MS analysis shows the existence of various compounds with different chemical structure. Thus, this type of GC-MS analysis is the first step towards understanding the nature of active principles in this medicinal plant and this type of study will be helpful for further detailed study.[4]

2. In-vitro Propagation

S. R. Saranya Krishnan et al., describes the report, by using a well-defined media formulation, maximum number of shoots (118.7 micro shoots/culture) were produced from *O. umbellata*. The auxin transport inhibitory effect of quercetin possibly minimized the chance of formation of unwanted rooting and callusing. As compared to previous methods for

in vitro propagation of *O. umbellata*, present method is simple and reproducible. The present method enables direct regeneration of plants from nodal segments thus ensuring genetic stability. Through *in vitro* culture, 118.7 shoots from single culture were produced and can be multiplied with fourfold increase in every subculture. The developed protocol is simple and reproducible and can be used for mass propagation and conservation of *O. umbellata* germplasm.[5]

3. Induction of Shoots from *In-vitro* Cultured Roots

M.S. Shekhawat et al., describes, the shoots were regenerated from the cultured roots of *Oldenlandia umbellata L.* successfully for mass propagation on Murashige and Skoog (MS) medium. The nodal shoots were cultured on 3.0 mgl-1 Benzylaminopurine (BAP) to induce nodal meristems. The shoots were multiplied well on MS liquid medium supplemented with 1.0 mgl-1 BAP + 0.5 mgl-1 Indole-3 acetic acid (IAA). Shoots were rooted on half strength MS medium supplemented with 2.5 mgl-1 Indole-3 butyric acid (IBA). The *in vitro* produced roots were further used as explants to initiate root cultures to get secondary metabolites (anthraquinone derivatives/dye). The root pieces were cultured on half strength MS medium supplemented with IBA. The multiplied roots turned yellow in color within 4-5 weeks. Shoots were regenerated from the roots when the roots cultured on MS medium augmented with 1.0 mgl-1 BAP. Again these shoots were rooted with help of IBA and the plantlets were hardened in green house.[6]

4. Foliar Micromorphological Response

Revathi Jayabal et al., describes about the plant tissue culture techniques offer quick methods of regeneration of plants of medicinal importance but the survival chances of such plants are always questionable when shifted to the in vivo conditions. The present study enumerates the micromorphological developments in the leaves of *in vitro* regenerated and field transferred plantlets of *Oldenlandia umbellata*. The leaves developed *in vitro* after 4th subcultures of multiplication phase and after 6 weeks of field transferred plants were used. Statistically significant differences in the number of stomata, veins, raphides, crystals and trichome density per square mm were observed. The improvements in stomatal apparatus and density (decreased from 41.85 to 32.20), developments in leaf architectural parameters and emergence of defense mechanism through increased numbers of raphides (8 to 15), crystals and trichomes (13.5 to 18.2) proved acclimation of tissue culture raised plantlets from *in vitro* to the in vivo environments lead to 100 % success in field establishment of the plantlets. The

in vitro induced foliar abnormalities (changes in stomata, venation pattern, vein density, trichomes, crystals etc.) were repaired while hardening of plantlets in the greenhouse and finally in the field. The observed micromorphological response of leaves under altered environmental conditions could help in determination of proper stage of field transfer and prediction of survival percentage of *in vitro* regenerated *O. umbellata* plantlets.[7]

5. Homostyly and Heterostyly

Bir Bahadur describes about the Homostyly in heterostyled *Oldenlandia umbellata L*., a species of the family Rubiaceae is described. Homostyles are of the short styled type. Measurements of homostyles are compared with the heterostyles. On the basis of self fertility the homostyles are named fertile and infertile. Results of pollination experiments in various combinations carried out within the heterostyles, in the homostyles and heterostyles are given. Among the incompatible crosses of heterostyles (both self and cross) the incompatibility is absolute in thrums while it is slightly relaxed in pins. Incompatibility is not observed in the bud pollinations. In the compatible pollinations the cross pin × thrum is more fertile than it's reciprocal. The fertile homostyle is the most fertile. Among the crosses, the cross pin × fertile homostyle is most fertile while the cross infertile homostyle × pin is the least fertile. A review of heterostyled species showing homostyly is also appended.[8]

6. Germplasm

S. R. Saranya Krishnan et al., describes an efficient *in vitro* propagation method for a dye yielding medicinal herb, *Oldenlandia umbellata L*. was established using benzyl adenine and quercetin. Nodal segments cultured on agar gelled Murashige and Skoog medium supplemented with benzyl adenine (5.0 lM) and quercetin (5 lM), produced maximum explant response (100 %) and number of shoots (118.67). Thus a continuous shoot multiplication system in every 4 weeks interval was established. Addition of quercetin in combination with benzyl adenine produced significantly (p\0.001) higher number of shoots than medium supplemented benzyl adenine alone and in short, addition of quercetin resulted in 1.5 fold increase in shoot number. Addition of 5 lM quercetin in combination with 5 lM benzyl adenine resulted in the production of 4.64 cm sized shoots with an average of 4.13 nodes per shoot. *In vitro* raised microshoots were rooted ex vitro, by a pulse treatment in 50 lM indole-3-butyric acid for 30 s, followed by planting in plastic cups containing potting mixture. Ex vitro planted microshoots were rooted and recorded high rate of survival (81.3 %). The present protocol in brief, suggests that by modifying auxin transport in a tissue

culture system, rate of shoot multiplication can be increased, thus facilitating mass propagation of plants having strong apical dominance.[9]

7. Auxin & Nutritional Stress Coupled Somatic Embryogenesis

S. R. Saranya Krishnan et al., described about the impact of nutritional stress in somatic embryogenesis from *O. umbellata*, and the study reveals that prolonged nutritional stress can induce 100% somatic embryogenesis (without any complex additives in the medium) from callus which can result in high turnout in tissue culture of *O. umbellata*. Further, the molecular mechanism behind the spontaneous triggering of somatic embryogenesis during nutritional stress needs to be studied.[10]

8. Embryology

G. Shivaramaiah et al., described about the embryology of *Oldenlandia umbellata Linn*. has been investigated. Floral parts arise in acropetalous succession. A transection of an young anther shows a group of microscope mother cells followed by a layer of tapetum, a middle layer, an endothecium and an epidermis. The uninucleate tapetum is of the glandular type. Microspore tetrads are tetrahedral and isobilateral. The pollen grain is binucleate at the time of anther dehiscence and the endothecium fibrillar. A hypodermal archesporial cell directly functions as the megaspore mother cell. Embryo sac development follows the Polygonum type. Fertilisation is porogamous. Endosperm is free nuclear and embryogeny conforms to the solanad type.[11]

9. Anthraquinone Production

S. R. S. Krishnan et al., describes abouts enhanced production of anthraquinones from cell suspension cultures of *Oldenlandia umbellata* were established through elicitor or precursor treatment. Stock cell suspension cultures were developed in liquid MS medium supplemented with 2.5 µM NAA using friable calli. Standardization experiments of suspension cultures revealed that 10 µM NAA added liquid MS medium was optimum for the growth and AQ accumulation from *O. umbellata* suspension cultures. 10 µM NAA produced 9.96 mg g -1dw AQ on 30th day of incubation. Later enhanced AQ production was achieved by the addition of elicitors or precursors into the standardized media on 25th day of incubation and AQ quantification was done after 5 days of incubation. Addition of elicitors or precursors resulted in a sudden increase in AQ content. 25 mg L-1 pectinadded suspension cultures produced 35.67 mg g-1dw AQ and precursor feeding with 50 mg L-1α-keto glutaric acid resulted in the accumulation of 42.63 mg g-1dw AQ. HPLC analysis of elicitor or precursor mediated

suspension cultures revealed the presence of alizarin and purpurin in samples. The overall AQ production by the addition of elicitors or precursors showed an increment when compared to that of control (9.44 mg g-1dw AQ).[12]

10. Noval pH Indicator

Siva Ramamoorthy et al., describes about the use and production of natural dyes has become more popular due to the growing awareness for the environment and concerns about the safety of synthetic dyes. The increasing market demand for dyes and the dwindling numbers of dye-yielding plants forced the emergence of synthetic dyes like aniline and coal-tar-based dyes, which has led to the replacement of natural dyes. However, even today, some dyes continue to be derived from natural sources; for example, dyes for lipstick are still obtained from Bixa orellana L. and Lithospermum erythrorhizon Sieb & Zucc., and dyes for eye shadow from Indogo. Another good example is from the study of Siva et al. (2008) showing the replacement of a synthetic tracking dye with a natural one. Numerous plant species have been found to have an important role in the day-to-day life of various indigenous communities. It is a matter of concern that the indigenous knowledge of extraction, processing and practice of using of natural dyes has diminished to a great extent among the newer generations from such communities due to easy availability of cheap synthetic dyes. It has been observed that the traditional knowledge of dye-making is now confined only to the surviving elder people and a few practitioners in the tribal communities. Unfortunately, no serious attempts have been made to document, preserve and take advantage of this immense treasure of traditional knowledge of natural dye-making associated with indigenous peoples. The lack of a focused conservation strategy could cause a depletion of this valuable resource. *Oldenlandia umbellata L*. is one such plant that has not been recognised properly. The red colour obtained from this plant can be used for several purposes including colouring fabrics or other materials, and for painting. Further critical study on this plant can make use of the pH indicator property. In this context, this article provides a scientific evaluation of the dye from *Oldenlandia umbellata L*., which can be used as a novel pH indicator.[13]

PHARMACOLOGICAL ACTIVITIES

1. Respiratory Tract Pathogens

R. K. Sujatha et al., describes the respiratory diseases are the major cause of death in the developing countries. To overcome the health problem people prefer allopathic medicine which cause side effects. In the modern world people were shifted to traditional system of

medicine. Because, it cure the diseases and also not cause any side effects. In the present study, the attempts are made to control the respiratory causative bacteria with traditional medicinal plant, *Oldenlandia umbellata*. Alcohol and aqueous extracts of the plant showed antimicrobial activity against the tested respiratory pathogens. The phytochemical analysis showing the presence of alkaloid, terpenoids, flavones, flavanoids, tannins, amino acids and these substances are responsible for antibacterial activity. This study scientifically proves the importance of plant products in development of a potent antibacterial agent. Further research will be carried to find all bioactivity of *Oldenlandia umbellata* root extracts.[14]

2. Anti-Bacterial Activity

P. Arun et al., describes about this medicinal plant has produce any antibacterial activity against any of common pathogenic organisms isolated from respiratory tract infections the whole plants (except leaves) of crude methanolic extract of *Oldenlandia umbellata* were tested against the pathogenic organisms isolated from the respiratory tract infections.*Oldenlandia umbellata* posses antibacterial activity against both gram positive and gram negative bacteria. It was found that the methanolic extracts of roots and aerial portion (except leaves) of *Oldenlandia umbellata* possessed high degree of antibacterial activity. However the leaves of this plant do not posses such activity. It has been reported that the plant *Oldenlandia umbellata* contains about seven Anthraquinones, of which 1-2-dihydroxy anthraquinone known as Alizarin is the most predominant. Fractionation of the methanolic extract of *Oldenlandia umbellata* revealed five different fractions presence of of Alizarin was observed in all the five fractions by both qualitative and quantitative estimations. This compound was found to be the active principle and was separated from the plant *Oldenlandia umbellata* by chromatographic procedures and identified as Alizarin. The plant derived Alizarin (OU-1) and the synthetic Alizarin (SA) exhibited similar antibacterial activity.[15]

3. Anti-Tussive Activity

G.R. Saraswathy et al., describes the benzene, petroleum ether and ethanol extracts of leaves of *Oldenlandia umbellata* were investigated for its anti-tussive effect on a cough model induced by sulfur dioxide gas in mice. The ethanol extract at doses of 250 and 500 mg/ kg showed maximum inhibition of cough reflex at 3 hours after drug administration and the anti-tussive activity was comparable to that of codeine phosphate, a standard anti-tussive agent.[16]

4. Anti-Inflammatory & Anti-Pyretic Activity

Padhy I P et al., describes the ethanolic extract of *Oldenlandia umbellata* (synonym: *Hedyotis umbellate*) root was screened for both anti-inflammatory and antipyretic activity in wistar albino rats. The extract showed significant anti-inflammatory activity in carrageenan induced paw oedema, which is comparable to that of the control and standard drug phenylbutazone. Antipyretic activity screened by brewer's yeast induced pyrexia in albino rats. It is comparable to that of paracetamol. The results indicated that *Oldenlandia umbellata* root is endowed with potential anti-inflammatory and antipyretic activity.[17]

5. Hepatoprotective Effect & Antioxidant Activity

Malaya Gupta et al., describes the protective mechanisms of methanol extract of *Oldenlandia umbellata* (MEOU) in carbon tetrachloride intoxicated rats. Rats are treated with carbon tetrachloride at the dose of 1 ml/kg body weight intraperitonially once every 72 hrs for 16 days. The hepatoprotective activity of methanol extract of *Oldenlandia umbellata* was evaluated by measuring levels of serum marker enzymes like serum glutamate oxaloacetate transaminase (SGOT), serum glutamate pyruvate transaminase (SGPT) and alkaline phosphatase (ALP). The serum levels of total protein and bilirubin were also estimated. The histological studies were also carried out to support the above parameters. Administration of MEOU (250 and 500 mg/kg, p.o.) significantly ($p< 0.05$) prevented CCl4-induced elevation of levels of serum GPT, GOT, ALP, and bilirubin. The total protein level was decreased due to hepatic damage induced by CCl4 and it was found to be increased in methanol extract of *Oldenlandia umbellata* treated group. Treatment of rats with CCl4 led to a marked increase in lipid peroxidation as measured by malondialdehyde (MDA). This was associated with a significant reduction of the hepatic antioxidant system e.g. reduced glutathione (GSH) and Catalase. These biochemical alterations resulting from CCl4 administration were significantly ($p< 0.05$) inhibited by pretreatment with methanol extract of *Oldenlandia umbellata*. The results are comparable with standard drug silymarin. A comparative histopathological study of liver exhibited almost normal architecture, as compared to CCl4 treated control group. These data suggest that the methanol extract of *Oldenlandia umbellata* may act as a hepatoprotective and antioxidant agent.[18]

6. Cytotoxicity Activity

S. Mahibalan, et al., describes the cytotoxic activity of *Oldenlandia umbellata* and its chemical constituents. Cell viability assay of crude methanolic extract of aerial parts of *O.*

umbellata (HUM), its ether soluble fraction (HUM-E) and butanol soluble fraction (HUM-B) against colon cancer HT-29, lung epithelial A549 and breast adenocarcinoma MDA-MB-231 cell lines showed HUM-E to be significantly cytotoxic with IC50 values of 25.7, 67.7 and 69.3 µg/mL, against HT-29, A549 and MDA-MB-231, respectively. Chemical investigation of HUM-E and HUM-B resulted in the isolation of a novel symmetrical coumarin dimer named oledicoumarin (1), together with eleven known compounds, hedyotiscone B (2), cedrelopsin (3), pheophorbide A methyl ester (4), deacetyl asperuloside (5), scandoside methyl ester (6), asperulosidic acid (7), scandoside (8), nicotinic acid (9), 6α-hydroxy geniposide (10) anthragallol 1,2-dimethyl ether (11) and anthragallol 1,3-dimethyl ether (12). All compounds were isolated for the first time from *O. umbellata* except anthragallols. This is the foremost report exploring the presence of coumarin derivatives in *O. umbellata*. Testing of cytotoxicity of isolated constituents revealed that compounds 3, 4, 11 and 12 showed significant inhibition against A549 cells with IC50 values of 3.6–5.9 µg/mL. Compounds 4, 11 and 12 showed marked inhibitory effect against MDA-MB-231 cells (IC50 3.6–9.1 µg/mL). Compounds 4 (IC50 1.7 µg/mL) and 7 (IC50 6.1 µg/mL) were highly active against HT-29 cells. In summary, the less polar fraction of *O. umbellata* and its constituents were found to be cytotoxic.[19]

7. Anti-Microbial Activity

Dr. P. Selvam et al., describes the ethanolic extract of *Oldenlandia umbellata* was screened for their antimicrobial activity against bacteria Streptoccocus pyrogenes, Staphyllococus aureus, Klebsiella pneumoniae, E coli, Pseudomonas aureginosa and Candida albicans. To assess the antimicrobial activity, a well-diffusion assay was carried out. 17 hrs of old bacterial cultures were inoculated over the agar surface of Mueller Hinton agar plates using sterile cotton swabs for the well diffusion assay. After 10 min, wells were cut using a cork borer and each well was loaded with 100 µl of compound from 10 mg/ml, 20 mg/ml and 50 mg/ml concentration stock (100 µg/well) along with DMSO control. At 37°C, the plates were incubated for 24 h.[8] Susceptibility was assessed on the basis of the diameter of the zone of inhibition (ZoI) against the test pathogens.[20]

CONCLUSION

According to the literature, the selected plant species showed significant medicinal values which are used traditionally to treat different diseases for centuries. The *Oldenlandia umbellate* available in many countries and the local community traditionally used it to treat

many diseases. The bioactive ingredients were isolated from the stems, leaves, roots and showed several pharmacological activities. Therefore, the investigation is focused on the selected plant species for the discovery of the new medicines to treat different diseases. Our present review aims to identify the present status of the phytochemical and pharmacological activities of the locally grown *O. umbellata* and it will help in many research. The current research would support further research initiatives in the future to further isolate new drugs that would benefit the pharmaceutical, agrochemical, and cosmetics industries.

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