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CONSTITUENTS AND PHARMACOLOGICAL IMPORTANCE OF *JUSSIAEA REPENS* - A REVIEW

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Abstract:
The phytochemical analysis of Jussiaea repens revealed that the plant contained squalene, betulonicacid, betulin, betulinicacid, a mixture of [2 4 R]-6β-hydroxy-stigmast-4-en-3-one and [22 E, 24 R]- 6 β -hydroxy-stigmast-4,22-dien-3-one, pteleoellagic acid 3,30,40-tri-O -methyl ellagic acid, dihydroquercetin or [+]-trans taxifolin, quercetin, protocatechuic acid, afzelin, quercitrin,, methyl gallate, gallic acid and myricitrin. The previous pharmacological researches showed that Jussiaea repens possessed haematinic, hepatoprotective, anti-diabetic, anti- inflammatory, cytotoxic, antimicrobial, antioxidant effects and many effects on male and female fertility. This review discussed the pharmacological and therapeutic effects of Jussiaea repens.

Keywords: *Jussiaea repens, pharmacology, therapeutic, chemical constituents*

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INTRODUCTION:

Medicinal plants had been used by all cultures throughout history. The World Health Organization [WHO] estimates that 80 percent of the world population, presently use herbal medicine for some aspect of primary health care. Plants are a valuable source of a lot of secondary metabolites, which exerted a wide range of pharmacological effects[1-10]. The phytochemical analysis of *Jussiaea repens* revealed that the plant contained squalene, betulonicacid, betulin, betulinicacid, a mixture of [2 4 *R*]-6β-hydroxy-stigmast-4-en-3-one and [22 *E*, 24 *R*]- 6 β -hydroxy-stigmast-4,22-dien-3-one, pteleoellagic acid 3,30,40-tri-*O* -methyl ellagic acid, dihydroquercetin or [+]-*trans* taxifolin, quercetin, protocatechuic acid, afzelin, quercitrin,, methyl gallate, gallic acid and myricitrin. The previous pharmacological researches showed that *Jussiaea repens* possessed haematinic, hepatoprotective, anti-diabetic, anti- inflammatory, cytotoxic, antimicrobial, antioxidant effects and many effects on male and female fertility. This review will discuss the pharmacological and therapeutic effects of *Jussiaea repens*

Plant profile:

Synonyms: *Ludwigia adscendens* [L.] H. Hara., *Jussiaea adscendens* L.[11-12]

Common names:

Arabic: Kubani; **Bengali**: Keshardam, Mulcha, Mulsi, Mochi, Pokal panlawang; **Chinese**: Yu chai cao, Shui lung; **English**: water-primrose, creeping water-primrose, floating primrose-willow, red ludwigia; **India**: keshandam; keshara; **Japanese**: mizukinbai; **Nepal**: Jadelo; **Philippines**: Sigang-dagat; **Spanish**: clavito, clavo de agua, mimbra; [12-15]

Distribution:

It was distributed in Asia [China, Bangladesh, India, Nepal, Sri Lanka , Cambodia, Laos, Myanmar, Thailand, Vietnam, Indonesia, Malaysia, Philippines, Japan, Jordan, Turkey, Iraq], Africa [Egypt, Benin, Gambia, Ghana, Kenya, Mali, Mauritius, Nigeria, Senegal, Sierra Leone, Tanzania, Uganda, Zimbabwe], Europe [Belgium, France, Germany, Italy, Netherlands, Spain, Switzerland, UK] and Australia[13, 15].

Description:

Herbs perennial, with creeping or floating stems, rooting at nodes, with white, erect, short [1–3 cm], spindle-shaped pneumatophores in clusters at nodes of floating stems. Floating stems to 400 cm, terrestrial stems 20–60 cm, much branched, tips ascending, glabrous or densely villous. Petiole 5–20 mm; leaf blade oblong to spatulate-oblong, 0.4–7 × 0.7–3 cm, glabrous, lateral veins 6–13 per side, submarginal vein not prominent, base narrowly cuneate or attenuate, margin entire, apex obtuse to subacute. Sepals 5, deltoid-acuminate, 5–11 mm, glabrous or villous. Petals creamy-white with yellow base, obovate, 9–18 × 6–10 mm. Stamens 10; filaments white, 2.5–4 mm; anthers 0.7–1.8 mm; pollen in monads. Style white, 4–10 mm, glabrous; stigma discoid. Capsule light brown with dark brown ribs, cylindric, terete, 1.2–2.7 cm, 3–4 mm in diam., glabrous or villous, thickly walled, tardily and irregularly dehiscent; pedicel 1.5–5.5 cm. Seeds in one row per locule, firmly embedded in coherent cubes of woody endocarp fused to capsule wall, pale brown, oblong or elliptic, 1.1–1.3 mm, raphe inconspicuous[16-17].

Traditional uses:

Decoction of dried material was used for colds with fever, intense coughing, and inability to urinate. Decoction was also used as astringent for dysentery. Pounded fresh material applied as poultice to carbuncle, sprains, and snake bites. In the Antilles, it was used as an emollient. In south western China, the plant was eaten as vegetable**.** Malays used it for poulticing skin complaints. In Papua New Guinea, stems and leaves of the plant were used as contraceptive[12].

The whole plant was used as antiseptic and as a poultice in ulcers. The plant was also used as emetic, laxative, anthelmintic and antidysenteric[18].

It was also used as diuretic, for the treatment of cough, Jaundice, gonorrhea, measles and erysipelas boils[19].

It was also used traditionally to prevent diabetes, as diuretics and for the treatment of fever and cough[10].

Fresh leaf paste was applied in boils and burns as coolant. Cooked shoot was eaten regularly in empty stomach against strangury[21].

In Papua, New Guinea, the leaves and stem of this plant were used as contraceptive[22].

Dried plant powder was applied externally on skin to cure various skin diseases[23].

Parts used: Entire plant[12].

Chemical constituents:

Leaves contained squalene, betulonicacid, betulin, betulinicacid, a mixture of [2 4 *R*]-6β-hydroxy-stigmast-4-en-3-one and [22 *E*, 24 *R*]- 6 β -hydroxy-

stigmast-4,22-dien-3-one, pteleoellagic acid 3,30,40-tri-*O* -methyl ellagic acid, dihydroquercetin or [+]-*trans* taxifolin, quercetin, protocatechuic acid, afzelin, quercitrin,, methyl gallate, gallic acid and myricitrin[24].

Gallic acid, p-coumaric acid, chlorogenic acid, myricetin and rutin were identified in the hot water extracts of L. adscendens leaf and stem[25].
Favonoids [quercetin, quercetin 3-O-rhamnoside or quercitrin, quercetin 3-O -galactoside, quercetin 3-O-glucoside,quercetin3-O-rutinoside, kaempferol 3-O-glucoside, myricetin 3-O-rhamnosideormyricitrin, andmyricetin 3-O -galactoside, rosmarinic acid, quercetin 3-O-β-D-glucopyranoside and kaempferol 3-O-β-D-glucopyranoside were isolated from the plant [19, 24, 26-27].

Nine compounds were isolated from L. adscendens, and seven of them were established as hexadecanoic acid, β-sitosterol, bentulinic acid, gallic acid, ursolic acid, quercetin-3-O-α-L-rhamnose and oleanolic acid[28].

A new acylated avicularin [avicularin 2"-[4"'-O-n-pentanoyl]-gallate] as well as trifolin 2"-O-gallate, quercetrin, guaijaverin, reynoutrin, juglanin, avicularin, hyperin, trifolin, hyperin 2"-O-gallate, rutin, kaempferol and quercetin were isolated from the ethyl acetate extract of the aerial parts of Jussiaea repens[29].
T
he leaves contained 22 identified long chain [C15–C36] *n*-alkanes, and an unknown number of unidentified branched chain alkanes. The predominant *n*-alkane was C25[11.02%], whilst C18 [7.62%], C20 [6.14%], C29 [5.36%] and C27 [5.29%] *n*-alkanes were moderately abundant, the C35 homologue was present only in minor amounts [0.22%][30].

The foliar fatty acid fractions and their relative concentrations in the *Ludwigia adscendens* were determined by TLC and GC-FID analyses of methyl esters in the n-hexane extract of mature leaves. The lipids content was 5.74% of the mg/g dry leaf tissue. Fatty acids identified were palmetic acid, oleic acid and stearic acid with 65.57, 4.85 and 10.79% concentrations, respectively[31].

Pharmacological effects:
Antioxidant effect:
Jussiaea repens was extracted with chloroform-methanol[1:2,V/V] and the extract was then partitioned with petroleum ether, EtOAc and BuOH. The three extracts were evaluated for antioxidant activities[AA] by Schaal method, and compared with that of BHT. The ethyl acetate-soluble fraction[EAF] exhibits the highest AA among the three fractions, which was higher than that of BHT. Rosmarinic acid, quercetin 3-O-β-D-glucopyranoside and kaempferol 3-O-β-D-glucopyranoside were the major antioxidant constituents in JRL. The antioxidant activities of the compounds decrease in the following order: rosmarinic acid > quercetin 3-O-β-D-glucopyranosid > kaempferol 3-O-β-D-glucopyranoside > EAF> BHT. The antioxidant activities of phenolic compounds were closely correlated to their chemical structures. In general, the antioxidant activities of phenolics depend mainly on the number of hydrogen-donating hydroxyl groups on the aromatic ring of the phenolic molecules[19].

Strong DPPH and NO scavenging activity as well as iron chelating activity was recorded in the L. adscendens leaf extract, which correlated to its high contents of gallic acid, pcoumaric acid and myricetin[25]

The antioxidant activities of twenty-six medicinal herbal extracts that have been popularly used as folk medicines in Taiwan was investigated. The results of scavenging DPPH radical activity showed that, among the 26 tested medicinal plants, *Jassiaea repens* exhibited antioxidant activities and its IC50 values for DPPH radicals was 103 µg/ml[32].

Effects on male and female fertility:

Oral administration of crude aqueous extract of *Jussiaea repens* to adult male albino rats at the doses of 100 , 200 and 400 mg / kg bw /day for 28 days, caused no significant change in body weight and organ weights like liver, kidney, spleen and heart but the weights of testis and cauda epididymis were significantly reduced, where the weight of adrenal gland showed significant rise in. Epididymal sperm concentration, motility and viability were significantly reduced but sperm abnormality was markedly increased in and IV. SGOT, SGPT, ALP, ACP, total protein, urea and creatinine level in serum were remained unchanged in treated groups. The fructose content of seminal vesicle and ventral prostate was reduced significantly. Accordingly, the oral administration of aqueous extract of *Jussiaea repens L* may be considered as nontoxic antifertile agent in male rat in a dose dependent manner[33].

The effects of crude queous extract of *Jussiaea repens* L [JR] 200 mg/kg bw/day for 28 days in rats] on sperm the DNA integrity of spermatozoa was studied. Toluidine blue [TB], acridine orange [AO]

and aniline blue [AB] staining were used to assess sperm chromatin / DNA integrity and comet assay for sperm DNA damage. The results showed that the DNA integrity or denaturation by TB, AO and AB positive staining of spermatozoa of JR treated group were significantly increased when compared with control. But TB positive staining was much higher [34.51%] than AO [27.06 %] and AB [18.91%] positive staining. No denaturation was observed in epididymal spermatozoa of rats after withdrawal of extract treatment. The results of Comet assay also support the reduced change in Head DNA % and increase in Tail DNA %, Tail length [TL], Comet length [CL]. All parameters returned almost towards control in withdrawal group, suggested the reversible action of extract[34].

The effects of the crude aqueous extract of *Jussiaea repens* on the normal histoarchitechture of testicular tissue and vis-à-vis functions was investigate Results showed that when crude aqueous extract of *J.repens* [except root] was fed orally at a dose of 200 mg/kg bw/day for a period of 28 days, caused marked alterations in histology of testis, reduction in seminiferous tubular and Leydig cell nuclear diameter. Spermatogenic stage count showed the arrest of spermatogenesis at stage VII followed by significant reduction in number of sertoli cells and spermatogenic cells. Histological studies of treated testis showed reduction in interstitial tissue with leydig cells, tubular lumen, mature spermatids, thickness of basal lamina with irregular outline and profuse intraepithelial vacuolation. Serum level of testosterone, LH, FSH and testicular testosterone were greatly reduced in treated group. All these effects were restored towards normal after withdrawal of treatment[35].

The effect of crude aqueous extract of *Jussiaea repens* [except root] at the dose of 200mg/kg bw/ day for 28 days in rats was studied on sperm quality and morphological alterations of sperm cells. The results showed that the extract induced alterations of sperm morphology was predominantly of primary abnormalities [40%], which included hook less, banana head, pin head, bent neck, bent tail, head amorphous and presence of cytoplasmic droplets. About 10% secondary abnormalities were found to have coiled tail or head less spermatozoa. The tertiary abnormalities [8%] , tailless or detached head and simple coil tail were also found. The presence of cytoplasmic droplets and disruption of plasma membrane of spermatozoa in treated group also confirmed the potentiality of this plant extract as an anti fertility agent[36].

The probable mode of action of *Jussiaea repens* [except root] as anti fertile agent was studied in rats. The aqueous extract at a dose of 200 mg/kg bw/day orally for 28 days exerted potent anti fertility activity that may be due to decreased testicular ascorbic acid, glycogen, Δ5-3β and 17β HSD, G-6PDH, ATPase, LDH activities and increased level of cholesterol, which are directly related to testicular functions. The testicular protein content was unaltered but Zn content was reduced insignificantly than control. Serum triglycerides, VLDL, LDH and G-6PDH were significantly reduced in treated group keeping HDL unaltered, but Zn content was reduced insignificantly. A significant decrease of protein content, Zn, ATPase and LDH activities in epididymis were also observed after treatment, which supported the anti gonadal activity. Altered biochemical parameters may affect the maturation process of spermatogenesis which was reflected through increased percentage of denatured chromatin in spermatozoa. Restoration of all the biochemical parameters in the recovery group supported the reversal effect of the extract after withdrawal of treatment[37].

The effect of crude aqueous extract of *Jussiaea repens* [200mg/kg bw /day for 28 days consecutively] was studied on the histoarchitecture of epididymis and its biochemical alterations in rats. As, histoarchitecture of epididymis and biochemical activities were correlated with sperm maturation, as the relationship between spermatozoa and microenviroimient of epididymis during the sperms remain in it, is important for male fertility. Extract caused significant reduction in epididymal sialic acid, glycogen, phospholipid, GSH, and testosterone level. But no change in total lipid and MDA level. Histological studies of epididymis showed the epithelial lining and basement membrane was thin and disrupted, the luminal diameter, epithelial height and nuclear diameter significantly reduced in treated group compare to control[38].

The aqueous extract of *J. repens* at oral dose of 200 mg/kg bw/day for 28 days caused no significant change in body weight but weight of testis and cauda epididymis, sperm motility, total sperm count from cauda epididymis, sperm viability and normal sperms were significantly reduced in treated group. The mating studies with treated group showed 25% having '0' implantation site. Withdrawal of drug for successive 28 days caused marked recovery in testicular and epididymal weight, sperm motility, count, viability and morphology possibly due to inhibition of spermatogenesis and steroidogenesis. The reversal studies caused recovery of reproductive

parameters towards normal revealing the nontoxicity[39].

The crude aqueous extract of *J. repens* [except root] was investigate on uterine contraction in *in-vitro* condition. The results showed that the crude aqueous extract of *Jussiaea repens* at a dose of 40mg dry extract / 30 ml physiological fluid in a bath, on isolated non pregnant uterus of adult female rats *in-vitro* causes significant increase of force and frequency of contraction than normal. The results [as percentage] were compared with the effect of oxytocin in presence of atropine. The results showed that the extract may act as oxytocin which was antagonized by atropine[40].

Haematinic effect:

Haematinic potential of *Jussiaea repens* [JR] [20 mg/100 gm bw/day orally] was studied in 2,4-DNPH induced anaemia [2 mg/100 gm bw/day, ip] in rats. Body growth rate was significantly [P<0.001] decreased in 2,4-DNPH induced anaemic group which was partially recovered in withdrawal and JR supplement. Liver weight was significantly decreased [P<0.01] in anaemic group than control but was significantly increased [P<0.01] in JR treatment. Spleen weight was significantly increased [P<0.05] in anaemic group but significantly decreased [P<0.05] in JR supplement and treatment. Significant decrease [P<0.05] in adrenal weight was found after 2,4-DNPH withdrawal, where other organs remain unchanged. The anaemic group showed insignificant reduction in total erythrocyte count and significant reduction [P<0.05] in haemoglobin concentration than control and were significantly recovered [P<0.05] after JR supplementation and treatment. PCV was significantly higher in withdrawal [P<0.05] and JR treatment [P<0.01] than anaemic group, where MCHC was significantly higher [P<0.01] only in JR treatment. But no remarkable change observed in MCH and total leukocyte count[20].

Hepatoprotective effect:

Elevated serum levels of both alanine transferase [ALT] and gamma glutamyl transferase [GGT] on infection with Schistosoma mansoni were significantly reversed in comparison to praziquantel, which in turn means the improvement of liver functions. Also, elevation of malondialdehyde [MDA] and glutathione [GSH] levels in liver homogenate [6- and 2-folds, respectively] was significantly reduced by 50% and 41% on treatment with the low dose of EA-extract [100mgkg bw]. The percentage of this reduction was increased at the high dose [200mgkg bw] in comparison with silymarin. This was an evidence of the strong antioxidant and consequently hepatoprotective effect of this extract, which could be attributed to its high flavonoids content[29].

Anti-diabetic effect:

EA extract [50mg kg bw] reduced significantly the elevated glucose level of alloxan-diabetic rats in comparison with glibenclamide which proved its significant antidiabetic activity[29].

Anti- inflammatory effect:

In comparison with mofebutazone, it reduced significantly elevated leukotriene B4 [LTB4] level in serum on infection with S. mansoni which proved its pronounced anti- inflammatory activity[29].

Cytotoxic effect:

The major isolates of the plant showed the highest cytotoxic activities against Ehrlich ascitis carcinoma cells lines [90% inhibition] which proved their anticarcinogenic potential[29].

Antimicrobial effect:

The methanolic extract of L. adscendens showed a broad spectrum antibacterial activity against all the tested bacteria except S. aureus. The zone of growth inhibition against the tested bacteria was: *Staphylococcus epidermis* 15, *Streptococcus pyogenes* 13, *Escherichia coli* 17, *Salmonella typhi* 20, *Shigella boydii* 18, *Shigella dysenteriae* 20, *Shigella flexneri* 15, *Shigella sonii* 17 and *Vibrio cholerae* 20mm[18].

Toxicity:

The investigated ethyl acetate extract was found to be non-toxic [LD50 up to the maximum soluble dose 4 g/kg bw][29].

CONCLUSION:

The review discussed the chemical constituents, pharmacological and therapeutic effects of *Jussiaea repens.*

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