Review Article

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A REVIEW ON PHYTOCHEMICAL AND PHARMACOLOGICAL PROFILE OF *PORTULACA OLERACEA* LINN. (PURSLANE)

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ABSTRACT
Portulaca oleracea belongs to the family of Portulacaceae in the traditional system of medicine and consists of large number of various medicinal and pharmacological importances hence represents a priceless tank of new bioactive molecules. *Portulaca oleracea* consists of number of pharmacological activities like antimicrobial, antioxidant, antidiabetic, neuronal, antinociceptive and anti-inflammatory activity. This review helps to create an interest in *Portulaca oleracea* in developing new formulations with more therapeutic and economic value.
Keywords: *Portulaca oleracea*, Pharmacological activities, Phytochemical

INTRODUCTION

Portulaca oleracea is an annual succulent in the family of Portulacaceae which may reach 40 cm in height. Approximately forty varieties currently are cultivated[1]. It has an extensive old World distribution extending from North Africa through the Middle East and the Indian Sub continent to Malaysia and Australia. The species status in the New World is uncertain: in general, it is considered an exotic weed, however, there is evidence that the species was in Crawford Lake deposits (Ontario) in 1430-89 AD, suggesting that it reached North America in the pre-Columbian era[2]. It is naturalized elsewhere and in some regions. It is considered an invasive weed. It has smooth, reddish, mostly prostrate stems and alternate leaves clustered at stem joints and ends. The yellow flowers have five regular parts and are up to 6 mm wide. Depending upon rainfall, the flowers appear at anytime during the year. The flowers open singly at the center of the leaf cluster for only a few hours on sunny mornings. Seeds are formed in a tiny pod, which opens when the seeds are mature. It has a taproot with fibrous secondary roots and is able to tolerate poor, compacted soils and drought.

The plant is traditionally used as anti-rheumatic and anti-fungal. This plant is also pharmacologically studied for its anti-fungal, anti-oxidant, anti-microbial, anti-inflammatory, anti-diabetic, diuretic, analgesic and wound healing properties.

Vernacular names

Tamil: Koli-k-kirai
Telugu: Peddapavilikura
Malay: Koluppa
Manipuri: Leibak kundo
Hindi: Lunia
Kannada: Dudagorai
Bengali: Nunia sag

Figure 1: ***Portulaca oleracea***

Botanical Study

Kingdom: Plantae
Order: Caryophyllales
Family: Portulacacaceae
Genus: Portulaca
Species: *P.oleracea*

Chemical Constituents

Purslane contains more omega-3 fatty acids, alpha-linolenic acid in particular than any other leafy vegetable plant. Purslane has 0.01 mg/g of eicosa-pentaenoic acid (EPA). This is an extraordinary amount of EPA for a land-based vegetable source. EPA is an Omega-3 fatty acid found mostly in fish, some algae, and flax seeds. It also contains vitamins (mainly vitamin A, vitamin C and some vitamin B and carotenoids) as well as dietary minerals such as magnesium, calcium, potassium, and iron. It also contains two types of betalain alkaloid pigments, the reddish betacyanins (visible in the coloration of the stems) and the yellow betaxanthins (noticeable in the flowers and in the slight yellowish cast of the leaves). Both of these pigment types are potent antioxidants and have been found to have anti-mutagenic properties. Many types of chemical compounds were present in this plant, including alkaloids,

terpenoids, organic acids, coumarins, flavonoids, volatile oil and polysaccharides[3].

Nutrition

100 Grams of fresh purslane leaves (about 1 cup) contain 300 to 400 mg of alphalinolenic acid[7] cup of cooked leaves contains 90 mg of calcium, 561 mg of potassium, and more than 2,000 IUs of vitamin A. A half-cup of purslane leaves contains as much as 910 mg of oxalate; a compound implicated in the formation of kidney stones however many common vegetables, such as spinach, also can contain high concentrations of oxalates[4].

Macroscopy

Leaves are about 0.4-2.5cm long, alternate, succulent, spathulate, truncate or retuse at apex, thick pale and glistering beneath, mucilaginous when crushed, very short petiolated, stipular appendages minute or absent, taste sour without any smell, petiole short about 1-1.5mm long and 0.5mm thick with greenish upper surface and reddish lower. The stem succulent, diffusely branched and felt very slippery due to presence of mucilage when crushed.They are about 2mm in diameter and the internodes are 1.5-3.5cm in length. Nodel appendages are less in number as compared to *Portulaca quadrifida minute* and *scarious*.

Microscopy

Transverse section the microscopic structure of the lamina of *Portulaca oleracea* resembles in many aspects to that of *Portulaca quadrifida*. The whole mesophyll consists of almost solely of aqueous tissue, the vascular bundles are surrounding by a sheath of green palisade cells as in *P.quadrifida*. The eragstic substance occurs in the form of prismatic and rossets (drues) of calcium oxalate crystals of different sizes in both species. The leaf of a plant is amphistomatic in contrast to *P.quadrifida* where it is epistomatic. The number of stomata on adaxial surface is higher than that of abaxial one. TS of petiole reveal that the lower surface is comparatively very much bulged, where the upper one slightly depressed. The uniseriate epidermis is made up of tangentially elongated tubular parenchymatous cells. The anticlinal wall of lower epidermal cells is curved and cells contain some dark pigment too. Ground tissue comprised of 4-6 layers of thin walled, rounded parenchmatous cells having distinct intercellular spaces. The vascular bundle about 2-4 in number, are collateral, closed, placed more or less centrally and arranged in an arch which opens towards adaxial side. Vesicles having helical and scaliferous thickenings show simple perforations, fibers often grow intrusively.

Traditional Uses

Burns and skin eruptions like boils and carbuncles can be treated with an effective concoction of the leaves. Extracts of Portulaca is effective in saving the skin from pollution and premature aging, which is why it is used in number of skin lotions[5].

Pharmacological Activities

Anti-microbial activity

Ramesh londankar and Hanumantappa (2011) had reported the phytochemical and anti microbial activity in aerial parts of chloroform and ethanolic extracts of *Portulaca oleracea* by agar diffusion method against five bacteria and three fungi (bacteria like *Staphylococcus aureus*, *Bacillus cereus*, *Klebisilla pneumonia* and fungi like *Aspergillus fumigates* and *Nerospora crassa*). Ethanolic crude extract showed maximum effect on organisms like *Staphylococcus aureus*, *Klebisilla pneumonia* and *Nerospora crassa*. Whereas chloroform extract showed moderate effect on *Klebisilla pneumoniae*, *Aspergillus niger* and *Nerospora crassa*. The results of this present study supported the folklore usage of the studied plant and suggest that, this plant extract posses compounds which is having antimicrobial properties and helps in developing antimicrobial agent in the form of drugs for the therapy of infectious diseases caused by pathogens[6].

Antioxidant Activity

Kamal Uddin *et al* (2012) had reported the antioxidant activity of *Portulaca oleracea* over the different growth stages by using 1, 1-diphenyl-2-picrylhydrazyl (DPPH), ferric–reducing antioxidant power (FRAP) assays and ascorbic acid content. There was a correlation between the results of total phenol content 174.5 ± 8.5 to 348.5 ± 7.9 mg GAE/100 g. and ascorbic acid equivalent antioxidant activity 60.5 ± 2.1 to 86.5 ± 3.9 mg/100 g and between DPPH scavenging IC_{50} (1.30 ± 0.04 to 1.71 ± 0.04 mg/mL) and ferric-reducing anti-oxidxant power assays ($r2 > 0.9$), The concentrations of Ca, Mg, K, Fe and Zn increased with plant maturity. Calcium (Ca) was negatively correlated with sodium (Na) and chloride (Cl), but positively correlated with magnesium (Mg), potassium (K), iron (Fe) and zinc (Zn). It was concluded that mature plants of *Portulaca olerecea* had higher total phenol content and antioxidant activities than plants at immature stages[7].

Anti-atherogenic, renal protective and immuno modulatory activity

Rasha Hamed mahmoud *et al* (2011) had reported the efficiency of purslane (components of ω-3 and ω-6) on hyperlipidemia, kidney function and as immunomodulators in rats fed high cholesterol diets. 40 male albino rats were divided into four groups: control group, hypercholesterolemic rats, fed the balanced diet supplemented with cholesterol at a dose level of 2 g/100 g diet; the other two groups of animals fed the same previous hypercholesterolemic diet supplemented with purslane (ω-3 and ω-6). The present study showed that 2% cholesterol administration caused a significant increase in total cholesterol, total lipids, and triacylglycerol in both serum and liver. Serum phospholipids, LDL-C, and atherogenic index (AI) also significantly increased compared to control group. Cholesterol-enriched diet significantly increased serum urea, creatinine, sodium and potassium levels as well as significantly increased serum IgG and IgM compared to healthy control. Consumption of purslane by hypercholesterolemic rats resulted in a significantly decrement in lipid parameters and significant improvement in IgG and IgM levels as compared with hypercholesterolemic rats. This result suggests that purslane had anti-atherogenic hypolipidemic and immunmodulator effects which were probably mediated

by unsaturated fatty acids (including alpha linolenic acid) present in seed mixture[8].

Anti hyperlipidemic activity

Sankar sastry pragda *et al* (2011) reported the anti hyperlipidemic activity of ethanolic extract of leaves of *Portulaca oleracea*. Test extracts (200 and 400mg/kg) treatment has showed significant inhibition against dexamethasone induced hyperlipidemia in adult wistar rats for 8 days. Biochemical parameters like total cholesterol, total triglycerides, phospholipids, high density lipoproteins (HDL), low density lipoproteins (LDL) cholesterol, very low density lipoprotein (VLDL) cholesterol, atherogenic index levels were measured and compared with standard gemfibrozil. The ethanolic extract showed a significant decrease in triglycerides ($p<0.01$), LDL ($p<0.001$), VLDL ($p<0.01$), HDL ($p<0.01$), cholesterol ($p<0.001$) respectively. This study revealed that the ethanolic extract showed good anti-hyperlipidemic activity[9].

Anti-arthritic activity

Jagan *et al* had (2011) reported the anti-arthritic activity of Petroleum-ether extract of *Portulaca oleracea* Linn by Fruends Adjuvant arthritis model in male wistar rats. The test extracts were at the dose of 100, 200 and 300 mg/kg/p.o. and standard as Indomethacin at a dose of 100mg/kg. A maximum of 77.82 % inhibition was observed on 21st day. In a similar fashion treatment with petroleum-ether extract also attenuated the increase in paw diameter due to Fruends adjuant administration, this was more pronounced at 300 mg/kg of petroleum ether extract of *Portulaca oleracea*. A maximum of 75.69% inhibition was observed on 21st day. This study revealed the anti arthritic activity of aqueous extract of *Portulaca oleracea*[10].

Anti-diabetic activity

Dae Gill Kang *et al* (2011) had reported the anti-diabetic activity in aqueous extract of *Portulaca oleracea* in rosiglitazone induced diabetics. *Portulaca oleracea* is an edible plant used as a folk medicine, on diabetic vascular complications. The diabetic mice were treated with *P. oleracea* (300mg/kg/day, p.o) for ten weeks, and *P. oleracea* treatment markedly lowered blood glucose, plasma triglyceride, plasma level of LDL –cholesterol and systolic blood pressure in diabetic mice. Furthermore, *Portulaca oleracea* significantly increased plasma level of HDL-cholesterol and insulin level. The impairment of ACh- and SNP-induced vascular relaxation of aortic rings were ameliorated by *P. oleracea* treatment in diabetic db/db mice and it also showed that over expression of VCAM-1, ICAM-1, E-selectin, MMP-2 and ET-1 were observed in aortic tissues of untreated db/db mice, which were significantly suppressed by treatment with *P. oleracea*. In this study it was found that the immune reactivity of the pancreatic islets remarkably increased in treated diabetic mice compared with untreated diabetic mice. Thus they concluded that *P. oleracea* suppresses the hyperglycemia and diabetic vascular inflammation, and prevents the development of diabetic endothelial dysfunction for the development of diabetes and its vascular complications[11].

Hepatoprotective activity

Anusha *et al* (2010) has reported the hepatoprotective activity of aqueous extract of the aerial parts of *Portulaca oleracea* in combination with lycopene against carbon tetrachloride induced hepatotoxicity in male wistar rats by intraperitoneal injection of carbon tetrachloride (0.1 ml/kg for 14 days). The aqueous extract of P. *oleracea* in combination with lycopene (50mg/kg) was administered to the experimental animals at two selected doses for 14 days. The hepatoprotective activity of the combination was evaluated by the liver function marker enzymes in the serum aspartase transaminases (AST), alanine transaminases (ALT), alkaline phosphatases (ALK.P), total bilirubin (T.B), total protein (T.P), total cholesterol (T.C), pentobarbitone induced sleeping time (PST) and histopathological studies of the liver. These studies concluded that both the treatment groups showed hepatoprotective activity against carbon tetrachloride induced hepatotoxicity by significantly restoring the levels serum enzymes to normal when compared with silymarin group and also concluded that oral administration of *Portulaca oleracea* in combination with lycopene significantly ameliorates carbon tetrachloride hepatotoxicity in rats[12].

Nephro-protective activity

Gholamreza Karimi *et al* (2012) reported the nephro-protective effect of aqueous and ethanolic extract of *Portulaca oleracea* against cisplatin-induced renal toxicity in rats. Single intraperitoneal injection of 4 mg/kg cisplatin was administrated to rats and determined the blood urea nitrogen and serum creatinine (SCR). After 5 days of investigation of the possible protective effect, *Portulaca oleracea* was administered as highest dose (0.8 and 2g/kg) for 6 to 12 h before cisplatin injection and had BUN and SCR levels significantly lower than those receiving cisplatin alone. The study concluded that the aqueous extract of *Portulaca oleracea* possess marked nephroprotective activity and could have a promising role in the treatment of acute renal injury induced by nephrotoxins, especially cisplatin[13].

Neuronal activity

Abdel Moneim *et al* (2011) had reported the neuronal activities of aqueous extract of Purslane (stems and leaves) with a dose of 1.5ml/kg in adult rats for 12 days. In this investigation there was significantly decrease in the Ca2+ level in cerebral cortex by about -25.2% at $p<0.05$. There was significantly decrease in dopamine content (31.2) in spinal cord. There was significant increase in dopamine content in cerebellum, cerebral cortex, thalamus and hypothalamus of rats. However significant decrease in norepinephrine content of spinal cord and mid brain, where in 5-HT serotonin significant increase in ($p<0.05$) pons (42.9), cerebral cortex (103.9), while significant decrease in spinalcord by -32.4%. This study concluded that the potential role of Purslane for neurotransmitters which is an integral part of many neurodegeneratives disorders[14].

Neuroprotective activity

Wanyin Wang *et al* (2007) had reported the neuroprotective activity of oral administration of *Portulaca oleracea* extracts or distilled water for seven days to the adult male mice. Animals were adapted to a

normobaric low oxygen environment (10% oxygenand 90% nitrogen) for different times and was sacrificed. The mouse cortices were used for histological analysis by heamtoxylin and eosin (H-E) staining. The activities of pyruvate kinase (PK), phosphofructokinase (PFK) lactic acid (LD) and the level of lactate dehydrogena and ATP were detected, and the mRNA and protein levels of EPO in the cortices were analysis. The results concluded that the degrees of brain inflammation were reduced due to administration of *Portulaca oleracea* extracts and also enhanced the increment of PFK, PK, and LDH and lessened the decrement of ATP[15].

Anti nociceptive and Anti inflammatory activity

Jagan Rao *et al* (2012) had reported the anti-nociceptive and the anti-inflammatory activities of the petroleum-ether extract of *Portulaca oleracea*. The petroleum-ether extract of *Portulaca oleracea* was subjected to a preliminary phytochemical screening study was carried out in Swiss albino rats with well established models like acetic acid induced writhing, formalin test and the tail immersion method in mice. Acute anti-inflammatory effect was studied by the Carrageenan induced hind paw oedema method in rats. The acute toxicity studies showed that the extract was non-toxic up to a maximum dose of 2000 mg/kg body weight. The petroleum-ether extract exhibited significant inhibition of the acetic acid induced writhing, it reduced the paw-licking response time significantly in the formalin test and it increased the withdrawal latency time in the tail immersion test. The Carrageenan induced hind paw oedema was significantly reduced in rats. By this study they concluded that the petroleum-ether extract of *Portulaca oleracea* had potential anti-nociceptive and anti-inflammatory activities[16].

CONCLUSION

It is quite evident from this review that *Portulaca oleracea* contains a number of phytoconstituents, which reveals its uses for various therapeutic purposes. The plant or its individual parts can be used for the treatment of various disorders in human being such as, diabetes, liver toxicity, fungal infection, microbial infection, inflammation, pyrexia and to relieve pain. Still, much work is required with the *Portulaca oleracea* to investigate the mechanism of actions with other therapeutic activities.

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