

A REVIEW ON TRADITIONAL HERB *PORTULACA OLERACEA*

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ABSTRACT

The plant *Portulaca oleracea* is used as medicinal herb atleast 2000 years ago and it is also used as food before this period. *Portulaca oleracea* belongs to the family Portulaceae, which is an annual herb. Its origin is unsure but archeobotanical findings are very common at many prehistoric sites. The plant approximately contains 30 different biological activities and over 60 medicinal indications. *Portulaca oleracea* is mentioned as alternative system of medicine because all parts of plant such as roots, stem, leaves, seeds possess the medicinal properties. It is a common herb used as vegetable. Its vernacular name

is Purslane, Hog weed, Kurfa, Andrachni, Baralunia etc. It has round, smooth, procumbent succulent stem, growing about 6 inches high with small oblong, wedge shaped dark green leaves, thick stalked and clustered together, flowers bloom in June and July which are yellow in colour. *Portulaca oleracea* is distributed all over the world and native of many parts of Europe, India, China, Japan etc. The plant is rich in Flavanoids, Alkaloids, Terpenoids, Organic acids, Vitamins, Minerals which are present in different parts of the plant such as stem, leaves, roots, seeds it is proved by qualitative phytochemical extract of plant by using different solvents. The plant *Portulaca oleracea* is reported to possess the multifaceted biological activities such as anti-ulcerogenic activity, antimicrobial activity, antioxidant activity, antidiabetic activity, anticonvulsant activity, antitussive effect, hepatoprotective activity, anti-inflammatory activity etc., It also possesses the antiimplantation and abortifacient

properties, bronchodilator property etc. The plant *Portulaca oleracea* is used since antiquity in Unani medicines for treating various ailments such as skin diseases, fever, dysentery, bleeding piles, spleen diseases etc. Moreover now-a-days *Portulaca oleracea* is used in cosmetics. The present review is an attempt to outline the recent knowledge of significant traditional uses, pharmacological activities, pharmacognostic and phytochemical study of plant *Portulaca oleracea*.

KEYWORDS: Vernacular names, Phytochemical constituents, Pharmacological activities, cosmetics, Unani.

1. History

The plant *Portulaca oleracea* is used as medicinal herb at least 2000 years ago but it was also used as food before this period. Portulacaceae is a family of perennial herb or annual herb and rarely as shrubs.^[1]

Interesting fact about Portulacaceae is it contains about 19 genera and 500 species. *Portulaca* includes 150 species it is an important genus of Portulacaceae family. One of the leading species in this genus is *Portulaca oleracea* Linn. Its origin is uncertain but archeobotanical findings are very common at many prehistoric sites. In archeological sites seeds were found in the northern Italy since the bronze age. The plant *Portulaca oleracea* is used by the Ancient Romans to treat dysentery, intestinal worms, headache and stomach ache. *Portulaca oleracea* has very important medicinal effects according to the Duke (2002).^[1]

Purslane in ancient times was looked upon as one of the anti-magic herbs, strewn around a bed was said to afford protection against evil spirits and nightmares. It has been used in salads and as a medicinal plant for hundreds of years. The juice of the stems and leaves is applied to scorpion sting. In Jamaica it is employed as a cooling and moistening herb in fevers. In North America it has been considered a cooling diuretic, and the seeds at one time were thought to be anthelmintic, though now known to be inert. In Indo China the juice of the fresh leaves is applied to abscesses, and used as a collyrium, a decoction is given in dysentery and liver diseases. In Nigeria the leaves are used as a local application to swellings.^[2]

The plant approximately contains 30 different biological activities and over 60 medicinal indications, so it is considered as medicinal food to consume similar to spinach. *Portulaca oleracea* is mentioned in the alternative system of medicine. All parts of the plant such as leaves,

seeds, roots, stem possess the medicinal properties. It is also included in the list of “World Economic plants”.^[1]

The *Portulaca* word is derived from the Latin in which *Portula* means little door, possibly from the type of dehiscence of the fruit. *Olera* means vegetable.^[1]

2. Scientific classification of *Portulaca Oleracea*^[3]

Kingdom-Plantae; Subkingdom-Tracheobionta

Superdivision-Spermatophyta; Division-Magnoliophyta

Class-Magnoliopsida; Subclass-Caryophyllidae

Order-Caryophyllales; Family-Portulacaceae

Genus-*Portulaca*. L; Species-*Portulaca oleracea* linn

4. Vernacular Name^[1]

Table 1: Vernacular names of *Portulaca oleracea*.^[1]

Arabic	Baqlatul Humqa, Khurfa, Baqlatul Mubarika, Rijala
Telugu	Gangavalli, Payala
Bengali	Baraloniya, Chotaluniya, Kulfi, Munya
Chinese	Machin Hsien
English	Common Purslane, Garden Purslane, Purslane
Greek	Andrachni, Andrakala, Antrakala
Hindi	Baralunia, Chhotalunia, Lonia, Lunia, Lunuk
Kannada	Doddagonisoppu, Gonisoppu
Persian	Cholza, Khurfah, Kurfah, Lonika
Sanskrit	Brihalloni, Lonika, Lonamla, Gholika, Lunia
Tamil	Karikkirai, Parapukkiray, Pullikirai, Pasalakkirai
Urdu	Khurfah

5. Characteristics of *Portulaca oleracea*

5.1 Microscopy^[4]

5.1.1 Microscopy of Leaf: Transverse section of the *Portulaca oleracea* resembles the *Portulaca Quadrifida*. Its whole mesophyll consists almost solely of aqueous tissue and its vascular bundles are surrounded by sheath of green palisade cells. The Vascular bundles are about 2-4 in numbers are collateral, closed.

The leaf is amphistomatic the number of stomata on adaxial surface is higher than that of the abaxial ones. The stomata present are paracytic and it consist subsidiary cells placed parallel to the pore on both sides of the leaf.

Transverse section of petiole at its lower surface is bulged while the upper one slightly depressed. The uniseriate epidermis is made up of tangentially elongated tubular parenchymatous cells. The anticlinal surface of lower epidermal cell is covered and it contains dark pigment.

Next to epiderm parenchymatous cells are present which consists brown tissue and comprises of 4-6 layers with distinct intercellular spaces. The outer layer is rich in calcium deposition and rich in chloroplast. The endodermis contains starch grains.

5.1.2 Microscopy of stem

Transverse section of the stem is circular in outline.

Epidermal cells polygonal in shape in shape and are surrounded externally by thick striated cuticle. Next to epidermis 2- 3layers of collenchymas cells, it is followed by isodimetric parenchymatous cells which are densely filled with starch grains.

5.2 Macroscopy^[1]

It has round, smooth, procum bent, alternate succulent stem growing about 6 inches high, with small oblong, wedge-shaped, dark green leaves, thick stalked and clustered together.

5.2.1 Stem: These flushed red or purple, not articulated, prostrate or decumbent, less often erect, diffuse much branched.

5.2.2 Leaves

These are alternate or occasionally subopposite, petiole short, leaf blade flat, obovate, cuneate, truncated rounded and apex obtuse.

5.2.3 Flowers

These bloom in june and july. Flowers are in clusters of 3-5 diameter is 0. 4-0. 5cm and surrounded by involucre of 2-6 bracts.

5.2.4 Seeds^[3]

These are reddish brown to black in colour with the diameter 0. 02-0. 03 inch. Seeds are oval and tiny it is prolific seeder. The number of seeds produced in single plant are 240,000 which may germinate even after 5-40 years when they reveal seeds on the surface of soil. It germinates in the end of the summer, flat mats of mature purslane can be turned over to reveal thousands of seeds on the soil surface.

6. Propagation of *Portulaca oleracea*^[3]

It germinates on the surface of soil after an irrigation or rain. The seeds grow rapidly into plant and produces flowers in a few weeks. The plant requires moist light with well drained soil in a sunny position. It does not produce any leaves if it grows in dry condition. The plant takes 40-56 days to produce crop from seed and can then be harvested by cutting the stem. The fleshy stem remains moist after harvesting and viable for several days and re-root to develop a new plant when it is re-irrigated.

7. Distribution^[3]

It is distributed all over world. It is native of many parts of Europe, India, China, Japan and a scension Island. It is also found in British Isles, America and Australia. It is distributed all over India, up to 170 m in the Himalaya and in all warm countries.

8. Habitat^[5]

It grows well in orchards, vineyards, crop fields, landscaped areas, gardens, roadsides, other disturbed sites.

9. Phytochemical Constituents^[6]

Some researchers have reported the following chemical components such as flavonoids, alkaloids, terpenoids, organic acids, vitamins, minerals present in different parts of the plant *Portulaca oleracea*.

9.1 Flavonoids present in different parts of the plant: Flavonoids such as Kaempferol present in the (Leaf and stem) parts, Apigenin present in (Leaf and stem) parts, Luteolin, Myricetin, Quercetin, Genistein, Genistin present in the (Whole plant). Portulacanonones A, Portulacanonones B, Portulacanonones C, Portulacanonones D, 2,2'-Dihydroxy-4',6'-dimethoxychalcone present in the (Aerial parts).

9.2 Alkaloids present in different parts of the plant

Alkaloids mostly present in the aerial part of the plant. Alkaloids such as Dopamine, Noradrenalin, present in the stem, leaf and seeds, Oleraceins A, Oleraceins B, Oleraceins C, Oleraceins D, Oleraceins E, Adenosine present in the whole plant of *Portulaca oleracea*, Oleracins I, Oleracins II present in the (Stem) parts, N-trans-Feruloyltyramine, (7'R)-N-Feruloylnormetanephine, 1,5-Dimethyl-6-phenyl-1,2-dihydro-1,2,4-triazin-3(2H)-one, (3R)-

3,5-Bis(3-methoxy-4-hydroxyphenyl)-2,3-dihydro-2(1H)-pyridinone, Thymine, N-trans-Feruloyltyramine, (7'R)-N-Feruloylnormetanephrine present in the (Aerial part) of the plant.

9.3 Terpenoids present in Aerial part of the plant

Terpenoids such as Portuloside A, Portuloside B, (3S)-3-O-(β -D-Glucopyranosyl)-3,7-dimethylocta-1,6-dien-3-ol, (3S)-3-O-(β -D-Glucopyranosyl)-3,7-dimethylocta-1,5-dien-3,7-diol, Portulene, Lupeol, (2a,3a)-3-[[4-O-(β -D-Glucopyranosyl)- β -D-xylopyranosyl]oxy]-2,2,3-dihydroxy-30-methoxy-30-oxoolean-12-en-28-oic acid are present in aerial parts of *Portulaca oleracea*.

9.4 Organic acids present in different parts of the plant

Organic acids such as 3-Quinolinecarboxylic acid, Indole-3-carboxylic acid, Catechol, Caffeic acid present in the Aerial parts of the *Portulaca oleracea*, α -Linolenic acid, Linoleic acid, Palmitic acid, Stearic acid, Oleic acid, present in the leaf part whereas p-Coumaric acid, Ferulic acid present in the (Whole plant), Docosapentaenoic acid, Eicosapentaenoic acid, Docosahexaenoic acid present in the (Stem parts), Lonchocarpic acid, Oxalic acid (leaf parts).

9.5 Vitamins: Vitamins such as Vitamin A, Riboflavin, Niacin, Pyridoxine, Vitamin C, Folates, Pantothenic acid, Thiamin, α -Tocopherol, Hesperidin are present in leaves of *Portulaca oleracea*.

9.6 Minerals: Minerals such as phosphorus, manganese, iron, calcium, copper are present in root stem and leaf whereas Zinc, selenium, magnesium are present only in the leaves of *Portulaca oleracea*.

9.7 Other compounds

Other compounds such as Portulacerebroside, β -Sitosterol, Daucosterol in the (Aerial part) of the plant, Glutathione, Proline, Melatonin, Chlorophyll, Tannin, Isopimpinellin, Robustin, Bergapten are present in the (Leaf) part of *Portulaca oleracea*.

10. Nutrition value of *Portulaca oleracea* per 100g.^[7]**Table 2: Nutrition value of *Portulaca oleracea*.^[7]**

Principle	Nutrient Value	Percentage of Rda Da
Energy	16 Kcal	1.5%
Carbohydrates	3.4 g	3%
Protein	1.30g	2%
Total fat	0.1g	0.5%
Cholesterol	0mg	0%
Vitamins	-	-
Folates	12µg	3%
Niacin	0.480mg	3%
Pantothenic acid	0.036mg	1%
Pyridoxine	0.073mg	5.5%
Riboflavin	0.112mg	8.5%
Thiamine	0.047mg	4%
Vitamin A	1320IU	44%
Vitamin C	21mg	35%
Electrolytes		
Sodium	45mg	3%
Potassium	494mg	10.5%
Minerals		
Calcium	65mg	6.5%
Copper	0.113mg	12.5%
Iron	1.99mg	25%
Magnesium	68mg	17%
Manganese	0.303mg	13%
Phosphorus	44mg	6%
Selenium	0.9µg	2%
Zinc	0.17mg	1.5%

The mineral content varies significantly in growth stages of plant and different parts like total phosphorous content found in higher quantity in leaves than roots and stem, iron content is greater in roots and leaves than in stem, manganese content is higher in roots than in leaves and stem. This plant is used for nutritive and medicinal purposes for centuries ago in China. It is also reported to possess oxalate content upto 671-869 mg per 100g of fresh leaves and mucilaginous substances of medicinal importance.

11. PHARMACOLOGICAL ACTIVITIES**11.1 Anti-ulcerogenic Activity**

One of the most effective constituents present in *Portulaca oleracea* are flavonoids which are biologically active and possess a wide range of pharmacological properties such as antibacterial, antiviral, anti-inflammation, and antioxidation properties. In the *Portulaca oleracea* plant, the flavonoids levels vary according to the part of the plant the highest levels

are present in the root followed by stem and the leaf; and seven different flavonoids are present in this plant, including kaempferol, myricetin, luteolin, apigenin, quercetin, genistein and genistin. However, only kaempferol and apigenin have been found in ethanolic extracts of leaves and stems, with the levels in the former being higher. *Portulaca oleracea* probably has gastric anti-ulcerogenic effect which could be due to its gastric acid anti-secretory effect, which provides scientific basis to the folkloric claim of the use of the plant as gastric sedative.

Banylla sn *et al.* investigated for antiulcer activity of the aqueous extract of *Portulaca oleracea*. L in aspirin plus pyloric ligation induced ulcer in albino rats. Ulcer index was decreased significantly by the dose of 500mg/kg and increased the gastric mucus barriers when compared to control. The anti-ulcer activity of plant may be due to the presence of Flavanoids such as kaempferol, apigenin, myricetin, quercetin and luteolin were identified in different parts of the plant *Portulaca oleracea* by phytochemical studies.^[8]

Karimi *et al.* also studied the aqueous and ethanolic of whole plant extracts in mice for their ability to inhibit gastric lesions induced by hydrochloric acid, absolute ethanol and pylorus ligation and it is compared with sucralfate. Both aqueous and ethanolic extract showed a dose dependent reduction in severity of ulcer. The highest dose of extract excited the similar activity to sucralfate.^[9]

Kumar A *et al.* evaluated the gastroprotective effect of 50% ethanolic extract (50, 100 and 150 mg/kg body weight BD. po.) of *P. oleracea* was assessed in different gastric ulcer models (i. e. gastric ulcers induced by ethanol, aspirin, cold restraint stress and pyloric ligation) in rats. Study showed dose dependent inhibition of ulcer index with maximum index reduction in ethanol and minimum in aspirin induced ulcer. Extract also prevents the oxidative damage of gastric mucosa by blocking lipid peroxidation and by significant decrease in superoxide dismutase and increase in catalase activity.^[10]

These studies show that *Portulaca oleracea* posses significant gastroprotective activity.

11.2 Antidiabetic effect

Shaimaa M Eldeighdye *et al.* had studied the therapeutic effect of purslane extract on wound healing in diabetic albino rats. Diabetes was induced in 3groups of rats by administration of STZ-nicotnamide (60,140mg/kg b. w) respectively. Total treatment was given

(40mg/280mm² wound) Purslane extract was applied for treatment of 250mm² full thickness open excision wound 3 times weekly for 21 days rats were sacrificed, blood and tissue samples were taken for analysis.

Total antioxidant capacity, fibrinogen, protein s, vascular endothelial growth factor (VEGF), protein c were analyzed histopathologically. The level of these has been exceeded in purslane with other groups. The purslane ethanolic extract plays an important role on accelerating diabetic wound healing and suppress the oxidative stress of STZ.^[11]

A study aimed at revealing the effects of polysaccharide from *Portulaca oleracea* on alloxan-induced diabetic rats and its mechanisms. The polysaccharide treatment resulted in significant decreases of fasting blood glucose, total cholesterol and triglycerides. Polysaccharide also showed a tendency of improvement body weight gain on diabetic rats. Furthermore, the diabetic control group had low serum insulin level comparing with that of normal control group, at the same time, the insulin levels were dose-dependently raised in the polysaccharide treated groups than that of diabetic control group. According to single cell gel electrophoresis and LD50 analysis, polysaccharide was proved to be nontoxic to the animals. The results indicate that polysaccharide would alleviate the blood glucose and lipid rising associated with diabetes and improve the abnormal glucose metabolism and increase insulin secretion by restoring the impaired pancreas cells in alloxan-induced diabetic rats, which suggest that polysaccharide has the hypoglycemic potential and could be useful on the diabetes therapy.^[12]

11.3 In Urinary Problems

The study was based on ethnobotanical interviews conducted from 1996-2000 in Trinidad and Tobago with thirty male and female respondents. A non-experimental validation was conducted on the different plants used for urinary problems and diabetes mellitus. Thus establishing that the plants used are safe and effective to help direct clinical trials. *Portulaca oleracea* was one of the plants having sufficient evidence to support their traditional use for urinary problems.^[2]

11.4 Anticonvulsant effect: The aqueous extract of the *Portulaca oleracea* leaves showed the anticonvulsant effect in healthy albino mice. The purslane extract significantly reduced the duration of tonic hind limb extension in maximal electroshock. Convulsion was induced

by pentylene tetrazole in a dose dependent manner, the aqueous extract delayed the onset and decreased the duration of clonic convulsions.^[13]

11.5 Antimicrobial effect

Dhole *et al.* studied the antimicrobial activity against two gram positive bacteria (*Bacillus subtilis*, *Staphylococcus aureus*) and one gram negative bacteria (*Pseudomonas aeruginosa*) by using the aqueous and ethanolic extracts of root and leaves of *Portulaca oleracea*. The highest antibacterial and antifungal activity was observed at the concentration of 750µg/ml. Ethanolic root extract was more potent to inhibit the growth of *Pseudomonas aeruginosa* while aqueous extract was comparatively more potent for *Bacillus subtilis*, *Staphylococcus aureus*.^[14]

Bae JH also assessed the antimicrobial effect of *Portulaca oleracea* extracts on food borne pathogen. He found that ethyl acetate extract of *Portulaca oleracea* showed strong antimicrobial activity against *Staphylococcus aureus* at 4000ppm concentration. This concentration retarded the growth of *Staphylococcus aureus* by more than 24 hours and *Staphylococcus dysenterica* upto 12hours at 37°C.^[15]

11.6 Bronchodilator effect

Boiled and aqueous extract of *Portulaca oleracea* showed a relatively potent relaxant effect in concentration dependent manner on guinea pigs tracheal chain which was compared with theophylline. These results were also comparable to greater than theophylline at different concentrations. This was reported by Boskabady *et al.*^[16]

11.7 Antioxidant effect

Vincenzo Sicari *et al.* reported the antioxidant effect of *Portulaca oleracea* Linn. In his study two different solvents MeOH/H₂O and EtOH were applied to fresh and dried leaves. The extracts were analysed using HPLC-DAD phenolic acids and flavonoids were identified in all samples. Total antioxidant activity was measured by using the albino rats (ABTS) and 1,1-diphenyl-2-picryl-hydrozyl (DPPH) and ferric reducing antioxidant power (FRAP) assay. Fresh hydroalcoholic purslane exhibited a promising radical scavenging activity.^[17]

Sanja *et al.* investigated the invitro antioxidant activity of the methanolic extract of *Portulaca oleracea* by 1,1-diphenyl-2-picryl-hydrozyl (DPPH) free radical scavenging activity by

alkaline DMSO method. The methanolic extract shows significant invitro antioxidant activity in higher dose than standard antioxidant.^[18]

Arda and co-workers examined the ability of *Portulaca oleracea* to reduce oxidative stress induced by vitamin A deficiency in male Wistar rats. The thiobarbituric acid-reactive substances (TBARS), reduced (GSH) and oxidized (GSSG) glutathione and antioxidant enzyme activities were determined in the heart and liver. The rats fed pure beta-carotene diet and diet supplemented *Portulaca oleracea* leaves, showed liver and heart TBARS concentrations lower than vitamin A-deficient diet rats. The liver GSH concentration of beta-carotene and *Portulaca oleracea* leaves feed rats was lower compared to vitamin A-deficient diet rats. The heart GSSG concentration of the purslane group was significantly lower than in vitamin A deficient rats. Liver and heart catalase activities were not significantly different among the groups, nor was heart glutathione peroxidase (GPX) activity; however the beta-carotene fed rats showed the highest liver GPX activity. There was no difference in liver glutathione-S-transferase level among the groups, while heart activity was higher in rats fed the vegetable leaves. This study evidences that the ingestion of purslane leaves may have a protective effect against oxidative stress caused by vitamin A deficiency.^[19]

11.8 Antitussive effect

Portulaca oleracea posses the antitussive effect which was proved by Boroushaki *et al.* He evaluated the antitussive effect of aerosols of two different concentration (2.5% and 5%) of boiled extract of *Portulaca oleracea*. Citric acid aerosol was used to induce the cough in guinea pigs and compared it with codeine (0.03 gm/ml) and saline. Both the concentrations of boiled extract codeine caused the significant reduction in numbers of citric acid induced coughs when it is compared to saline ($p < 0.001$). However, the antitussive effect of 5% concentration of boiled extract was significantly different with that of codeine. There was also significant difference between antitussive effect of both boiled extracts ($p < 0.001$).^[20]

11.9 Hepatoprotective activity

Prabhakaran *et al.* evaluated that the suspension of methanol and petroleum ether extracts of *Portulaca oleracea* in methyl cellulose for hepatoprotective activity in wister albino rats by inducing hepatic injury with D-galactosamine (400mg/kg). Altered biochemical parameters were significantly restored at the dose levels of 200mg/kg and 400mg/kg. When compared to D-galactosamine and silymarin treated groups. Histology of the liver section of albino rats also showed to significantly prevent D-galactosamine toxicity as revealed by the

hepatic cells with well preserved cellular architecture. Biochemical and histological data confirmed significant hepatoprotective activity of these extracts.^[21]

Al-Howiriny investigated the hepatoprotective effect of freeze dried juice extract of *Portulaca oleracea* in carbon tetrachloride (ccl₄) induced acute hepatotoxicity in rats. The extract was given in the dose of (150 mg/kg and 300mg/kg) for 10 consecutive days prior to carbon tetrachloride (ccl₄) administration. Therefore the extract prevented the increase in the serum levels of hepatic enzymes, glutamate oxaloacetate transamine, glutamative pyruvate transaminase, gamma glutomyl transferase, alkaline phosphatase and bilirubin. Moreover purslane extract significantly prevented the carbon tetrachloride (ccl₄) induced prolongation in pentobarbitone sleeping time in mice. These findings proved that *Portulaca oleracea* prevent acute liver damage through its intrinsic antioxidative chemical components which act as a powerful antioxidant.^[22]

11.10 Anti-inflammatory activity

Young ock kim *et al.* investigated the anti inflammatory effect of *Portulaca oleracea* on the LPS- iinduced RAW 264.7 cells. He studied the effect of aqueous extract of *Portulaca oleracea* om proinflammatory mediators secreted from lipopolysaccharide-activated macrophage cells (RAW 264.7) as an established inflammation model. Anyi-inflammatory effect of *Portulaca oleracea* was compared withindomethacin. *Portulaca oleracea* did not show any cytotoxic effects at the concentration of 0. 2 mg/ml. When RAW 264.7 macrophages were treated with *Portulaca oleracea* together with LPS, at (1µg/ml) concentration dependent inhibition of nitrogenoxide production was detected. Western blotting revealed that the *Portulaca oleracea* blocked protein expression of iNos in LPS-stimulated RAW 264.7 macrophages significantly. The change in the contents of PGE₂, 1L-6 and TNF-α were monitored by enzyme linked immunosorbent assay (ELISA) and compared with indomethacin. *Portulaca oleracea* has much more potency and inhibited the the production of PGE₂, 1L-6 and TNF-α in LPS-induced RAW 264. 7 macrophages cells at concentrations of 0. 05,0. 1 and 0. 2 mg/ml (P<0. 05). Therefore these results suggested that *Portulaca oleracea* posses a potential therapeutic effect by inhibiting the inflammation process such as arthritis.^[23]

11.11 Neuroprotective effect

Wang *et al.* investigated the hypoxic neuroprotective effects of *P. oleracea* extracts in mice. After oral administration with the extracts or distilled water for seven days, mice were kept in

a normobaric low oxygen environment (10% oxygen and 90% nitrogen) for different time and then were sacrificed. The mouse cortices were used for histological analysis. The activities of pyruvate kinase (PK), phosphofructokinase (PFK), lactic acid and the level of lactate dehydrogenase (LDH) and ATP were detected and the mRNA and protein levels of EPO in the cortices were analyzed. PC-12 cells and primarily cultured nerve cells were used for 3-(4, 5-Dimethylthiazol2-yl) 2,5-diphenyltetrazolium bromide assay. Their results showed that the *P. oleracea* extracts enhanced the EPO mRNA and protein expression in the mouse cortices. Compared to the control group, the mouse in the group treated with the PO extracts by 1 g/d had significantly higher activities of PF, PFK, LDH and higher levels of ATP in the cortices, especially under the hypoxic environment for 24 h. Histological analysis indicated that the extracts lessened the inflammation damage of the mouse brain. MTT assay results showed the extracts or the herb-containing serum raised the viability of the cells under the tested hypoxic conditions and decreased the degree of LDH in the culture medium in a dose-dependent manner. These results showed that PO extracts had protective effects on hypoxic nerve tissue.^[24]

Li-wei *et al.* evaluated the effects of flavones extracted from *Portulaca oleracea* on ability of hypoxia tolerance in mice. They found survival time of mice in hypoxic conditions in flavones treated group was significantly longer than that in the untreated group. The RBC, Hb concentration, HCT, plasma EPO level and the relative values of EPO in RNA in renal tissue and pallium of mice were significantly higher in the flavones treated group than those of untreated group.^[25]

Hingxing *et al.* investigated the neuroprotective effects and mechanism of aqueous extract of *Portulaca oleracea* at the doses of 2.5, 5 and 10 mg/kg per day on SD mice injected daily with d-gal (50mg/kg/day) by behavioral tests. When compared to d-gal treated mice, the extract treated mice showed higher activity upon induction by new environmental stimuli, lower anxiety and higher novelty-seeking behaviour in the open field tasks and significantly improved learning and memory ability, when compared with d-gal-treated mice.

Extract significantly increased superoxide dismutase activity and decreased the malondialdehyde level. They found that p21 waf1 was down regulated by this extract without changing the expression of p53. They concluded that the effects of extract might be carried out through a p21 waf1-dependent and p53-independent pathway.^[26]

In another study, Moneim *et al.* demonstrated that purslane aqueous juice administration significantly increased the different monoamines, acetylcholinesterase activity in rats due its content of melatonin, omega-3 fatty acid, phenolic and flavonoids compounds and other active ingredients, suggesting the potential role of purslane for neurotransmitters which is an integral part of many neurodegenerative disorders.^[27]

11.12 Effect of *Portulaca oleracea* on smooth muscle blood pressure

An aqueous extract of *Portulaca oleracea* leaves and stems produced a dose dependent relaxation of guinea pig fundus, tacnia coli and rabbit jejunum and a dose-dependent contraction of the rabbit aorta.

On spontaneously beating rabbit right atria and electrically-paced left atria, the extract produced a dose dependent negative inotropic and chronotropic effects. On rat blood pressure the extract produced dose-dependent pressor responses. Phentolamine reduced the contractile responses on aorta as well as the pressor response on the blood pressure.

Guanethidine and tetrodotoxin has no effect on extract induced relaxant or contractile responses. On rat blood pressure atropine and cyproheptadine has no effect on extract induced pressor-responses. Where as propranolol slightly reduced the pressor -response.

An increase in extracellular calcium reversed the inhibitory effect of the extract on the rabbit atria. They concluded that the extract may act in part on post synaptic alpha-adrenoreceptors and by interference with transmembrane calcium influx.^[28]

11.13 Anti-implantation and abortifacient properties

Londonkar R, Nayaka HB, evaluated the Anti-implantation and abortifacient properties of *Portulaca oleracea* in albino rats. In this study petroleum ether, chloroform and ethanol crude extract of aerial parts of *Portulaca oleracea* were administered orally in albino rats at the dose of 500mg/kg and 250mg/kg body weight per day for 7 days and effect of Anti-implantation and abortifacient was investigated. The treatment of petroleum ether crude extract has shown 20% and 30% reduction in implantation activity at low (250mg) and high (500mg) doses respectively. The chloroform extract has shown 50% and 60% reduction in implantation activity at low (250mg) and high (500mg) doses respectively. Whereas ethanolic crude extracts have shown 40% and 50% reduction in implantation sites with respect to low and high doses of extract treatment. Ethanolic crude extract treatment exhibit abortifacient

activity but petroleum ether and chloroform extract treatment to pregnant rats did not show any abortifacient activity.^[29]

11.14 Nephroprotective activity

Aqueous and ethanolic extract of *Portulaca oleracea* against cisplatin induced acute renal toxicity was studied in rats. Treatment with aqueous and ethanolic extracts in the highest dose (0.8 and 2 g/kg), 6 and 12 hour before cisplatin injection reduced blood urea nitrogen and serum creatinine. Tubular necrotic damage was also not observed. In another group rats treated with aqueous and ethanolic extract, 6 and 12 hr after cisplatin injection also had blood urea nitrogen and serum creatinine levels significantly lower than those receiving cisplatin alone but mild to moderate cell injury was observed.^[30]

11.15 Skeletal muscle relaxant activity

The Skeletal muscle relaxant activity of aqueous extract of the stems and leaves of *Portulaca oleracea* were evaluated by the Parry *et al.* They found that the extract abolishes the twitch contraction of the directly stimulated rat hemidiaphragm preparation. They further investigated the effect of the extract mimic qualitatively the action of potassium oxalate which is known constituent of *Portulaca oleracea* on the diaphragm. Removal of potassium (K^+) ions from methanol extract by passing it through a cation exchange resin reduced the inhibitory effect of the extract. A positive correlation between the concentration of potassium ions in the extract and the chloride of similar molarity. Therefore the results proved that the potassium ion content of *Portulaca oleracea* is at least partly responsible for the relaxant effect observed on the isolated rat diaphragm.^[31]

Okwuasaba *et al.* investigated the skeletal muscle relaxant properties of an aqueous extract of this plant on the twitch and tetanus tension evoked by electrical stimulation using the rat phrenic nerve hemidiaphragm and frog sciatic nerves sartorius muscle preparations and on contractures induced by nicotinic agonists using the rat rectus abdominis muscle preparation.

Their observations indicate that the aqueous extract possesses unique skeletal muscle relaxant properties which do not appear to involve interference with cholinergic mechanism(s). They concluded that the mechanism of action of the extract may involve interference with Ca^{2+} mobilization in skeletal muscle.^[32]

11.16 Analgesic activity

Heng-zhi wang, Chuan-jin wang evaluated the analgesic activity of natural Allantoin from *Portulaca oleracea* seed. Allantoin was isolated from *Portulaca oleracea* seed for first time and analgesic effect was evaluated in acetic acid-induced abdominal constriction tests in mice with i. p injection. The result indicated that the analgesic effect of allantoin was almost as strong as aspirin. Allatoin was observed to be analgesic with dose dependence proliferation and the tested mice did not exhibit a tendency to be addicted to allatoin. These results suggested that allatoin could be a promising candidate as novel analgesic agent.^[33]

11.17 Wound healing activity

The preliminary wound healing activity of *Portulaca oleracea* was studied using *Musculus svi-1*. Fresh homogenized crude aerial part of *Portulaca oleracea* were applied topically on the excision wound surface as single dose in different amounts. The results suggested that *Portulaca oleracea* accelerates the wound healing process by decreasing the surface area of the wound and increasing the tensile strength. The greatest contraction was obtained at a single dose of 50mg and second greatest by two doses of 25mg. Measurement of tensile strength healed area were in agreement.^[34]

11.18 Anti-tumor activity

Shiva khatibi *et al* investigated the cytotoxic an antiproliferative effect of *Portulaca oleracea* ethanolic extraction on Helacell line. In this study, Hela cells were cultured and exposed to various concentration of *Portulaca oleracea* ethanolic extract for 24 and 48 hours. Cytotoxicity and cell viability were evaluated, usin MTT (3-(4,5-dimethylthiazole-2yl)-2,5-diphenyltetrazolium bromide) and trypan blue respectively. However the results suggested that ethanolic extract of *Portulaca oleracea* effectively decreased proliferation of Hela cell ($P < 0.001$). It also decreased the viability of the cells after treatment with extract ($P < 0.001$) and it exerts its time and dose dependent effect.^[35]

12. Insecticidal and Wormicidal Acivity of *Portulaca oleracea*

The seeds and leaves of *Portulaca oleracea* are reported for highly significant wormicidal and insecticidal activity.^[36]

13. Toxicity Studies

Dried powder of *Portulaca oleracea* were extracted by the dipping method with methanol, ethanol, acetone, ethyl acetate, ether, tri-chloromethane, dichloromethane, benzene and

petroleum ether and bioactivity of the extracts against *Aphis gossypii* Glover including contact toxicity and anti-feeding toxicity were approached. The results indicated that the methanol extract showed the highest contact toxicity among the 9 different extracts and the dichloromethane extract had the highest anti-feeding toxicity. No data on the toxicity of *Portulaca oleracea* could be found in the literature. However, the plant does contain cardiac glycosides and oxalic acids, which can be toxic.^[37]

14. Pharmacological actions in traditional and ethnomedicine^[1]

The important actions in alternative system of medicine and ethnomedicine show the precision of the data. Its comparison provides a concise summary that the alternative system of medicines itself has tremendous evidences not a mere of chance. Action mentioned in ethnomedicine are Anaphrodisiac, emollient, calmative, diuretic, antiscorbutic, vermifuge, refreshing agent, alterative, aperients. The diuretic action is probably due to the presence of high percentage of potassium salts.

14.1 Therapeutic uses mentioned in ethnomedicine

Since antiquity this herb is use as vegetable, spice and medicinal plant in Egypt and England. Its earliest recorded use dates back to around 500 AD in China in the Ben Cao Jing Ji Zhu. Traditionally, it is considered sour tasting and cold with heat relieving and detoxicant properties. It is considered to have blood cooling and hemostatic properties hence useful internally in bleeding bacillary dysentery, hematochezia (bloody stool), bleeding haemorrhoids and metrorrhagia. Externally, it is useful in bleeding condition. The whole plant and leaves are used in China as sour, diuretic, cooling herb that lowers fever and clears toxins. The leaves are used for poulticing tumors, bed wounds, ulcers and edematous swellings, also for hemorrhage and leucorrhea. The seeds decoction is considered as excellent diuretic.

In Africa whole plant is considered as antiphlogestic and bactericidal in bacillary dysentery, diarrhea, hemorrhoids, enterorrhagia and used as antidiabetic. It is used externally as cataplasm for maturing of the abscesses. The seeds are considered calmative and useful in polydypsia. The herb is generally used for heart trouble in Ghana. The plant is used in the treatment of hemoptysis and pulmonary diseases and decoction of leaf (macerated leaf in cold water) is useful in palpitation. The American Indians, for the treatment of colds used purslane and decoction of the herb is also useful in gout and headache. In inflammation of male genitalia the juice of the plant is beneficial. The leaves are infused in linseed oil as a liniment

for stiff neck. The Indians use this plant for treating excessive menstrual flow, stomachache, hemoptysis and inflammation of stomach. The mixture of plant juice with honey is used for cough.

15. *Portulaca oleracea* in cosmetics^[7]

Portulaca oleracea possesses anti-aging properties due to the presence of vitamin C, copper and manganese that act as powerful antioxidants that stimulate the production of collagen which is an anti-wrinkle remedy.

Purslane is a very good source of alpha-linolenic acid. Alpha-linolenic is an omega-3 fatty acid. Omega-3 fatty acids belong to a group of polyunsaturated fatty acids essential for maintenance of a healthy skin. Omega-3 fatty acids greatly benefit skin by regulating oil production to boost hydration and prevent acne and by delaying the skin's aging process. Omega-3 is present in the *Portulaca oleracea* which keeps the skin youthful. These fats help to keep skin-cell walls strong and flexible and avoid cell membrane to become stiff.

Portulaca oleracea is also rich in vitamin E, vitamin C and carotene and other antioxidants. These compounds help in reducing oxidative damage to skin cells that can lead to fine lines, wrinkles, dark spots and other signs of aging. It is also rich in vitamin A which is a natural antioxidant value. Purslane contains the highest content of vitamin A.

It also contains two types of betalain alkaloid pigments, the reddish betacyanins which is visible in the coloration of the stems and the yellow betaxanthins which is found 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.

15.1 *Portulaca oleracea* is also used for sunburn relief in the following way

Purslane supplements that contain dried and powdered leaves in capsules are added to half cup of boiling water. Then stir the mixture and rest it for 1 h. Then strain the mixture and pour the resulting extract in spray bottle to that add 1 cup of water and 1 teaspoon olive oil. After all shake the spray bottle and this spray is used for sunburn relief.

15.2 Specific uses of *Portulaca oleracea* in cosmetic field

- Purslane is used in the treatment of wrinkles and also to improve aesthetic appearance of skin.

- Ameliorate signs of dermatological aging.
- It is used for treating fine lines and to remove scars and blemishes.
- It protects the skin from UV-rays.
- An exfoliation promoter and an antioxidant.
- Minimizes sunburning and tanning.
- Iron and copper also aid in improving hair growth.

16. *Portulaca oleracea* in unani^[1]

Portulaca oleracea actions mentined in Unani medicines are Dafe humma (antipyretic), Habis dam (styptic), Mudir baul (diuretic), dafe ishal (antidysentric).

Portulaca oleracea seeds posses the less action when compared to whole plant. Juice of *Portulaca oleracea* (30gm) with sugar is administered orally is beneficial for intestinal worm infestation, whereas whole plant cooked with onion and ghee is beneficial for bilious dysentery. Paste of the plant with rose oil relieves headache and the whole plant act as refrigerant and useful in excessive thirst. The paste of plant with rose oil is also used on burn wounds, inflamed area, orchitis and pleurisy.

It is aphrodisiac for the person with hot temperament while cold temperament person it may reduce libido. Whole plant is also useful in gastritis. Juice of leaves and branches (60gm) is commonly useful in dysuria.

Macerated leaves are given orally to treat high fever. It is also a hemostatic thus used in polymenorrhagia, bleeding piles, hemoptysis. It helps in thickening of blood and also helps in cleansing the teeth. The juice alone or incorporated in powder is applied in eyes is beneficial in conjunctivitis and intestinal ulcers. Roasted given internally to cause constipation, whereas unroasted seeds cause laxative. Seeds with honey are used as aphrodisiac. Its seeds with sheera of leaves of khas are beneficial in enhancing sleep. It is used as diuretic and and also removes stones from kidney.

Dosage of the whole plant juice is given is 36 to 72gm where as seeds 6-7gm.

Future Prospective

As *Portulaca oleracea* is a traditional herb having various beneficial and medicinal properties, it can be used to make various formulations such as tablets, gels, suspensions,

ointments etc. As it possesses the various phytochemical constituents such as Flavanoids which may be useful for the preparation of anti-ulcer formulations. In future it may be useful in the preparation of many formulations for treating diabetes, ulcers, inflammation, convulsions, heart diseases etc due to the presence of alkaloids, flavanoids, terpenoids, organic acids, vitamins, minerals etc as it possesses the less side effects when compared to the synthetic drugs.

CONCLUSION

Portulaca oleracea is a unique traditional herb which is used by ancient Romans to treat dysentery, intestinal worms, headache, stomach aches. The plant itself possesses approximately 30 different biological activities and over 60 medicinal indications. Extensive survey of literature reported that the *Portulaca oleracea* possesses different phytochemical constituents such as alkaloids, flavanoids, terpenoids, organic acids, vitamins, minerals and high content of nutrients. As a matter of fact that it possesses a wide range of pharmacological activities like anti-ulcerogenic effect, anti-diabetic effect, anti-microbial activity, neuroprotective effect, antioxidant property, antitussive effect, analgesic effect etc, with less side effects when compared to synthetic drugs. *Portulaca oleracea* is in use since antiquity in Unani medicines for treating various ailments such as skin diseases, fever, dysentery, bleeding piles, spleen diseases etc. Moreover now-a-days it is useful in cosmetics the plant which is rich in omega-3 fatty acids which helps the skin cells be flexible. This review concludes that *Portulaca oleracea* may have a significant role in health care.

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Conflicts of interests

We declare that there are no conflicts of interests.

Abbreviations Used

Po-*Portulaca oleracea*; Bw-Body weight

VEGF-Vascular Endothelial Growth Factor

STZ-Streptozotocin

LD50-Lethal dose

HPL-DAD-High-Performance Liquid Chromatography with Diode-Array Detection

ABTS-Albino Rats

DMSO-Dimethyl Sulfoxide

GPX-Glutathione peroxidase

TBARS-Thiobarbituric acid-reactive substance

GSH-Glutathione; ELISA-Enzyme Linked Immunosorbent Assay

Summary

The plant *Portulaca oleracea* were in use atleast 2000 years ago. Plants consist of different Vernacular names and has specific characteristics. The *Portulaca oleracea* itself posses the various phytochemical constituents in different parts of the plant and pharmacological activities. It is abundant in nutritious value. *Portulaca oleracea* is often used in cosmetics and Unani.

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