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Purslane (Ghol Bhaji): A Functional Food Crop with Nutritional, Medicinal Use and Assessment of Pharmacology Activity

Gayatri Shelake and Rushita Shitole
Nootan Collage of Pharmacy, Kavthe Mahakal, India

Abstract: *Purslane (Portulaca oleracea L.) GHOL BHAJI is a globally prevalent summer weed that holds significant promise as a cultivated crop. Recognized for its exceptionally high content of omega-3 fatty acids—particularly alpha-linolenic acid—it also contains a range of powerful antioxidants, including α-tocopherol, α- carotene, vitamin C, and glutathione. Noteworthy characteristics include its rich crude protein levels, polysaccharides suitable for gum production, and notable resistance to saline conditions. This review explores the plant's origins, as well as its botanical and physiological attributes. In addition, it highlights the nutritional and medicinal benefits of purslane based on various chemical studies. The article concludes by assessing its agricultural potential, particularly in the context of pre- packaged salad mixes and other horticultural applications.*

Keywords: Purslane, antioxidants, anti-aging, skincare, formulation [1]

I. INTRODUCTION

Portulaca oleracea(GHOLBHAJI), a succulent annual herb from the Portulacaceae family, can reach heights of up to 40 centimeters. There are currently about forty known cultivated varieties. The species is native to the Old World, with a range that stretches from North Africa through the Middle East and the Indian subcontinent, all the way to Malaysia and Australia. Its presence in the New World, particularly in North America, is still debated. Though often labeled as an introduced weed, archaeological findings from Crawford Lake in Ontario—dating between 1430 and 1989 AD—hint that the plant may have been present in North America before European contact. Today, it has become naturalized in many parts of the world and is even considered invasive in some locations.[2]

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Characteristics of the Plant:

Portulaca oleracea is easily identified by its smooth, reddish stems that typically spread low along the ground. Its leaves are alternately arranged and tend to cluster around the stem joints and tips. The plant produces small, bright yellow flowers with five symmetrical petals, each measuring up to 6 mm across. Flowering can occur throughout the year, influenced primarily by rainfall, and blooms typically appear in the center of leaf clusters, opening briefly during sunny mornings.

Seed development takes place in small pods that burst open when mature. The plant features a main taproot, supported by a network of fibrous lateral roots. This root system enables the plant to adapt well to poor, compacted soils and survive extended dry spells. Traditionally used to treat conditions like rheumatism and fungal infections, *P. oleracea* has also been the focus of pharmacological research for its wide-ranging therapeutic effects. These include antioxidant, antimicrobial, anti-inflammatory, anti-diabetic, diuretic, pain-relieving, and wound-healing properties.[3,4,5,]

Vernacular Names of *Portulaca oleracea*

Tamil: Koli-k-kirai
Telugu: Peddapavilikura
Malay: Koluppa
Manipuri: Leibak Kundo
Hindi: Lunia
Kannada: Dudagorai
Bengali: Nunia Sag
Hindi: Khursa Badi-noni luniya
Gujarati: Motiloni Ghol
Assamese: Noniya Malbhog-sak ,Khutura Nunia-sak ,Malbhog khutura ,Malbhog xak Hah ,thegia.

Botanical Classification of *Portulaca oleracea*:

Kingdom: Plantae
Order: Caryophyllales
Family: Portulacaceae
Genus: *Portulaca*
Species:*Portulaca oleracea* L.

Omega-3 fatty acids are defined by their molecular structure, typically comprising carbon chains of 18 to 24 atoms with three or more double bonds [6]. These essential fats are most commonly found in oily fish, prompting health organizations to recommend regular fish consumption, as plant-based dietary sources are relatively limited [7]. However, *Portulaca oleracea* (purslane) has recently emerged as one of the most significant plant sources of alpha-linolenic acid (ALA), a key omega-3 fatty acid vital for human health [8].

Chemical Constituents and Nutritional Composition:

Portulaca oleracea contains a wide variety of bioactive compounds, including alkaloids, terpenoids, organic acids, coumarins, flavonoids, volatile oils, and polysaccharides.

Nutritionally, 100 grams of fresh purslane leaves (approximately one cup) provides between 300 and 400 mg of alpha-linolenic acid [8]. Additionally, half a cup of cooked leaves contains around 90 mg of calcium, 561 mg of potassium, and over 2,000 IU of vitamin A [8]. Notably, purslane is one of the richest leafy vegetables in terms of omega-3 fatty acid content, particularly alpha-linolenic acid, surpassing other commonly consumed greens [9].

Remarkably, it also contains 0.01 mg/g of eicosapentaenoic acid (EPA)—a type of omega-3 fatty acid more typically found in fish, some algae, and flaxseed. This level of EPA is exceptionally high for a terrestrial plant source [10]

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Health Benefits:

1. Wound Healing:

Purslane has shown promise in promoting wound healing due to its antioxidant and anti-inflammatory properties.

2. Liver Health:

Studies suggest purslane may be beneficial for liver health, particularly in individuals with non-alcoholic fatty liver disease (NAFLD).

3. Diabetes Management:

Purslane may aid in managing diabetes by helping to lower blood sugar levels and improve lipid profiles, according to some research.

4. Rich in Vitamins and Minerals:

Purslane is a valuable source of essential nutrients, including vitamins A and C, as well as minerals like potassium, magnesium, and calcium.

5. Anti-inflammatory Properties:

Purslane contains compounds with anti-inflammatory effects, which can help reduce inflammation throughout the body.

6. Antioxidant Properties:

Purslane is packed with antioxidants, which help protect the body against damage caused by free radicals.

7. Omega-3 Fatty Acids:

Purslane is a good source of omega-3 fatty acids, which are beneficial for heart health, brain function, and overall well-being.

8. Digestive Health:

Purslane's fiber content can promote healthy digestion and prevent constipation.

9. Bone Health:

Purslane's calcium and magnesium content can contribute to strong and healthy bones.

10. Eye Health:

Vitamin A in purslane is crucial for maintaining healthy vision and preventing age- related eye diseases. .

Traditional Uses:

In traditional medicine, leaf preparations of Portulaca oleracea have been used to treat burns, skin eruptions, boils, and carbuncles. These topical applications are known for their soothing and healing effects. Additionally, extracts of Portulaca are believed to protect the skin from environmental pollutants and premature aging, which has led to their incorporation into various skincare products and lotions [11].

II. PHARMACOLOGICAL ACTIVITIES

1. Anti-microbial Activity:

The antimicrobial activity of Portulaca oleracea was evaluated using chloroform and ethanolic extracts from its aerial parts. The extracts were tested against five bacterial strains and three fungal species using the agar diffusion method. Among the bacterial strains tested, Staphylococcus aureus, Bacillus cereus, and Klebsiella pneumoniae were targeted, while fungal species like Aspergillus fumigatus and Neurospora crassa were also included. The ethanolic extract

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exhibited the most significant antimicrobial effects against Staphylococcus aureus, Klebsiella pneumoniae, and Neurospora crassa. In contrast, the chloroform extract demonstrated moderate activity against Klebsiella pneumoniae, Aspergillus niger, and Neurospora crassa. These findings support the traditional use of Portulaca oleracea and suggest that it contains bioactive compounds with potential for developing antimicrobial agents to combat infectious diseases caused by these pathogens [12,13].

2. Anti-atherogenic, Renal Protective, and Immunomodulatory Activity:

A cholesterol-enriched diet led to significant increases in serum levels of urea, creatinine, sodium, potassium, and immunoglobulins (IgG and IgM) when compared to healthy controls. However, the inclusion of purslane in the diet of hypercholesterolemic rats resulted in a marked reduction in lipid parameters and a significant improvement in IgG and IgM levels. These findings suggest that Portulaca oleracea possesses anti-atherogenic, hypolipidemic, and immunomodulatory effects, likely attributed to the unsaturated fatty acids (including alpha-linolenic acid) present in the seed mixture [14]The anti-atherogenic, renal protective, and immunomodulatory activities of Portulaca oleracea.

3. Anti-hyperlipidemic Activity:

Biochemical parameters, including total cholesterol, triglycerides, phospholipids, high-density lipoproteins (HDL), low-density lipoproteins (LDL), very low-density lipoproteins (VLDL), and the atherogenic index, were measured and compared to the standard drug gemfibrozil. The ethanolic extract of Portulaca oleracea resulted in a significant reduction in triglyceride levels [15]. the anti-hyperlipidemic activity of Portulaca oleracea and its effects on various lipid parameters.

4. Anti-diabeticActivity:

Kang et al. (2011) reported the anti-diabetic effects of the aqueous extract of Portulaca oleracea in a model of rosiglitazone-induced diabetes. In this study, diabetic mice were treated with Portulaca oleracea at a dose of 300 mg/kg/day (oral administration) for ten weeks. The treatment resulted in significant reductions in blood glucose levels, plasma triglycerides, LDL-cholesterol, and systolic blood pressure. Additionally, Portulaca oleracea significantly increased plasma HDL- cholesterol and insulin levels in the treated mice [16].

Moreover, the impairment in acetylcholine (ACh)- and sodium nitroprusside (SNP)- induced vascular relaxation of aortic rings observed in diabetic db/db mice was ameliorated by Portulaca oleracea treatment. The expression of vascular cell adhesion molecules (VCAM-1), intercellular adhesion molecule-1 (ICAM-1), E- selectin, matrix metalloproteinase-2 (MMP-2), and endothelin-1 (ET-1) was found to be elevated in the aortic tissues of untreated diabetic mice, but this overexpression was significantly suppressed by the treatment with Portulaca oleracea. Additionally, the immune reactivity in the pancreatic islets was markedly increased in the treated diabetic mice compared to untreated controls. The authors concluded that Portulaca oleracea not only suppresses hyperglycemia but also alleviates diabetic vascular inflammation, thus potentially preventing the development of endothelial dysfunction associated with diabetes and its vascular complications [17].

5. Hepatoprotective Activity

The hepatoprotective effects of a Portulaca oleracea and lycopene combination were evaluated by measuring liver function marker enzymes in the serum, including aspartate transaminase (AST), alanine transaminase (ALT), alkaline phosphatase (ALP), total bilirubin (T.B), total protein (T.P), and total cholesterol (T.C). In addition, pentobarbital-induced sleeping time (PST) and histopathological studies of the liver were conducted. The results indicated that both treatment groups exhibited significant hepatoprotective effects against carbon tetrachloride-induced hepatotoxicity. The serum enzyme levels were restored to normal levels, showing a similar effect to the silymarin group. The study concluded that the oral administration of Portulaca oleracea, in combination with lycopene, significantly ameliorated carbon tetrachloride-induced hepatotoxicity in rats [18]. the hepatoprotective activity of Portulaca oleracea, specifically its effects on liver function markers and histopathological studies.

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6. Anti-nociceptive and Anti-inflammatory Activity:

Jagan Rao et al. (2012) investigated the anti-nociceptive and anti-inflammatory properties of the petroleum ether extract of Portulaca oleracea using various well- established animal models. The extract was subjected to preliminary phytochemical screening and tested in Swiss albino rats using acetic acid-induced writhing, the formalin test, and the tail immersion method in mice. Acute anti-inflammatory effects were evaluated using the carrageenan-induced hind paw edema model in rats. The study also included acute toxicity testing, which revealed that the extract was non-toxic at doses up to 2000 mg/kg body weight.

The petroleum ether extract showed significant inhibition of acetic acid-induced writhing, a reduction in the paw-licking response time in the formalin test, and an increase in withdrawal latency time in the tail immersion test. Additionally, it significantly reduced carrageenan-induced hind paw edema in rats. The authors concluded that the petroleum ether extract of Portulaca oleracea possesses notable anti-nociceptive and anti-inflammatory activities, supporting its potential use in pain and inflammation management [19]. the anti-nociceptive and anti-inflammatory activities of Portulaca oleracea, specifically through the use of its petroleum ether extract in established animal models

7. Neuronal Activity

Abdel Moneim et al. (2011) investigated the neuronal effects of the aqueous extract of Portulaca oleracea (stems and leaves) in adult rats, using a dose of 1.5 mL/kg for

12 days. The results showed a significant increase in dopamine levels in the cerebellum, cerebral cortex, thalamus, and hypothalamus. The rats were adapted to a normobaric low oxygen environment (10% oxygen and 90% nitrogen) for different durations before being sacrificed. The cortical tissue of the mice was then analyzed histologically using hematoxylin and eosin (H&E) staining.

Further biochemical analyses revealed that the activities of pyruvate kinase (PK), phosphofructokinase (PFK), and lactate dehydrogenase (LDH), as well as the levels of lactate dehydrogenase and ATP, were significantly enhanced in the cortices. Additionally, the mRNA and protein levels of erythropoietin (EPO) in the brain were analyzed. The study concluded that Portulaca oleracea administration reduced brain inflammation and improved the activities of key enzymes (PFK, PK, LDH) while mitigating the decrease in ATP levels [21]. the neuronal activity of the aqueous extract of Portulaca oleracea in rats and its effects on various brain regions and enzymes.

Side effects:

Purslane consumption is generally safe, but potential side effects include increased risk of kidney stones due to high oxalate content, and in some cases, allergic reaction Individuals with a history of kidney stones or allergies should exercise caution or Salt Content of Purslane can be higher in salt than other vegetables due to its succulent nature, so individuals on a low-salt diet should be mindful of their sodium intake or avoid purslane altogether.

II. CONCLUSION

This review highlights the significant potential of Portulaca oleracea (purslane) due to its diverse phytochemical composition, making it a promising candidate for various cosmetic applications. Rich in antioxidants such as vitamins A and C, alpha- tocopherol, and beta-carotene, along with omega-3 fatty acids, purslane also demonstrates wound-healing properties and antimicrobial activity. Furthermore, its traditional use in treating topical inflammatory conditions reinforces its value. Together, these characteristics position purslane as a valuable ingredient in both cosmetics and pharmaceuticals.

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