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Ethnopharmacology investigation of the potential curative and medicinal applications of weed from the Portulacaceae plant family

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Abstract
P. oleracea is an herbaceous plant that is also known as purslane in the United States and Australia, rigla in Egypt, pigweed in England, pourpier in France, and Ma-Chi-Xian in China. It is widespread around the world and readily grows in a variety of soil types. It has a long history of consumption as a nutritive and ethnomedical meal all across the world. Purslane has several advantages that have made it a valuable wonder crop, and experts from all over the world are very interested in using it as a nourishing meal in the near future. This review aims to highlight and critically evaluate the pharmaceutical potential of *Portulaca oleracea* by compiling the literature on its pharmacological effects, including antimicrobial, antioxidant, anti-inflammatory, wound-healing, antiulcerogenic, and ethnopharmacological activities. Study outlines purslane's history, botanical characteristics, and physiological characteristics while describing its nutritional and therapeutic benefits considering the findings of several investigations on its chemical composition.

Keywords: *Portulaca oleracea*, purslane, weed, antimicrobial, antioxidant, anti-inflammatory, wound-healing, antiulcerogenic

1. Introduction
The Portulacaceae family includes the warm-climate, herbaceous, succulent annual plant *Portulaca oleracea* L. with a global range. Common names for it include purslane in the United States and Australia, rigla in Egypt, pigweed in England, pourpier in France, and Ma-Chi-Xian in China [1]. The Mediterranean region and tropical Asian nations use it extensively as a potherb and to season soups and salads [2]. It is widely dispersed in tropical and subtropical regions of the world, including many regions of the United States. The seeds of this plant are ground into flour by Americans and Australian aborigines for use in mushrooms and bread [3]. Due to its abundance of omega-3 fatty acids and antioxidant qualities, *Portulaca oleracea* also offers nutritional advantages [4].
Numerous cultures have used *Portulaca oleracea* as a traditional medicine owing to its febrifuge, antiseptic, vermifuge, and various other effects [5]. It shows a variety of pharmacological activities, like antibacterial [6], antiulcerogenic [7], anti-inflammatory [8], antioxidant [9], and wound-healing qualities [10].
The World Health Organization lists it as one of the most famous medicinal plants and refers to it as a "Global Panacea" [11]. It was referred to as a "vegetable for long life" in Chinese mythology, and traditional Chinese medicine has relied on it for thousands of centuries [12, 13]. It is intended to chill the blood, control bleeding, expel heat, and remove toxins. It is cold in nature and sour in taste. With a dosage of 9-15 g, the dried aerial part of this plant is recommended for the treatment of fever, dysentery, diarrhea, carbuncle, eczema, and hematochezia [14, 15, 16].
A weed having a herbaceous aspect is known as purslane or *Portulaca oleracea*. In Hindi, it is commonly referred to as "Rudravanti," in Oriya as "Dahna," and in Kashmiri as "Nuner." Since the plant generates a milky fluid it is suggested that the name Portulaca comes from the Latin words porto, which signifies to convey, and lac, which signifies milk [17]. It is found throughout India, in all warm countries, and up to 170 m in the Himalayas.

Fig 1: (*Portulaca oleracea* L.)

It develops in virtually any open area that remains shaded, including flowerbeds, cornfields, and waste zones. The temperate regions of Europe, America, Canada, New Zealand, Australia, and India are all native to purslane [18]. Purslane stems and leaves have been consumed and taste quite like spinach. In medicine, this plant's aerial sections are used as an antibacterial and to decrease pain and swelling. The dried plant can be boiled and used for making soup or tea in China. This plant's aqueous extract did not exhibit any cytotoxicity or genotoxicity. Purslane is considered as a safe everyday veggie as a result of this. This plant's methanolic extract shows anti-microbial effectiveness against the bacteria *Bacillus subtilis* [19].

2. Taxonomy [20, 21]

Kingdom: Plantae
Subkingdom: Tracheobionta
Super division: Spermatophyta
Division: Magnoliophyta
Class: Magnoliopsida
Subclass: Caryophyllidae
Order: Caryophyllales
Family: Portulaceae
Genus: Portulaca
Species: *P. oleracea* L

3. Geographical Distribution

Purslane exists worldwide; *Portulaca oleracea* is a herbaceous annual native to numerous areas of Europe, as well as China, Japan, the East and West Indies, and Ascension Island. It is also found in the British Isles, but it is not native to those areas [22]. This plant can grow easily in warm, humid, dry, and semi-arid areas [21].

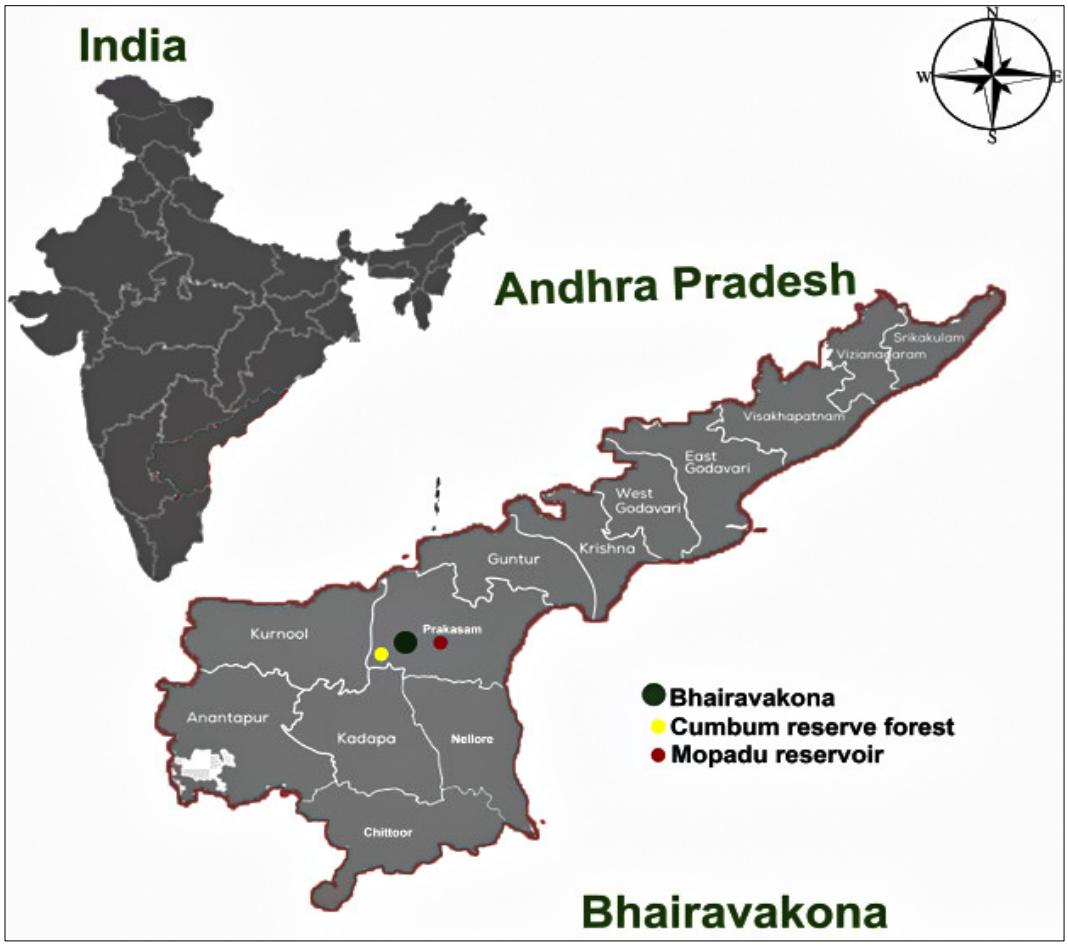

Fig 2: (a) Geographical distribution in India

Fig 3: (b) Geographical distribution in Andhra Pradesh

4. Ethnobotany and Traditional knowledge

Portulaca oleracea is a well-known medicinal plant that is used both as a traditional medicine and as an edible plant for treating a variety of disorders. It is a frequently utilized plant in traditional medicine in Europe. Dioscorides (40-90 CE) defines *Portulaca oleracea* as 'andrachne'. In his De *Materia Medica*, he defined the plant as an astringent, a remedy for headaches, inflammation of the eyes and other organs, stomach burning, 6 erysipelas, bladder disorders, teeth numbness, excessive sexual desire, burning fevers, worms, dysentery, hemorrhoids, swollen eruptions, and steps bites. Furthermore, he considered that *Portulaca oleracea* was helpful for healing head pustules and profuse intestinal discharges [23].

It was initially utilized in China around 500 AD, according to records from history. This plant is usually thought of with a chilly, sour taste, as well as heat-excusing and detoxicant effects. It was also used as a replacement for medicine. It works as an antipyretic, styptic, diuretic, antidycentric, and antihelmintic in Unani medicine [24]. It has been reported to have potent diuretic effects as well as a moderate laxative effect [25].

Purslane was used by American Indians to treat colds, and a solution of the herb is also useful for gout and headaches. The plant's juice has advantages for treating male genital edema. Indians use this herb to cure hemoptysis, heaviest menstrual flow, and stomachaches [26] and gastrointestinal irritation. Honey and plant juice are used for treating coughs [27].

Traditional ethnobotanical knowledge is an invaluable, underutilized, and under-documented information resource that will help in protecting and sustainable use of natural resources as well as bridging the knowledge gap that occurs between older and younger generations. This plant has been used as a vegetable, spice, and medicine from ancient times in Egypt and England [24].

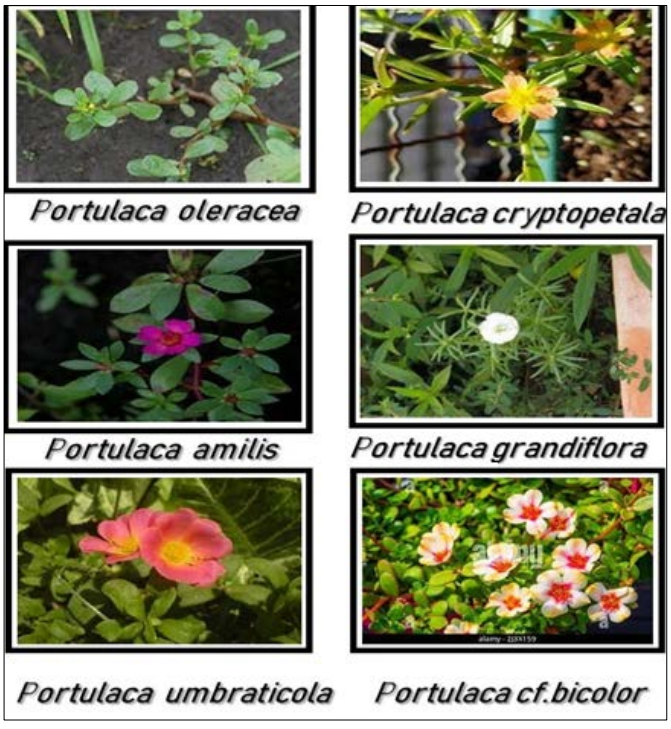

Fig 4: Different species of Portulaca

5. Ethnopharmacology

Purslane has been used for healthcare for a long time to treat a wide range of diseases. *P. oleracea* has multiple health advantages, such as analgesic, anti-inflammatory, diuretic, anti-fever, vermifugal, antioxidant, anti-bacterial, anti-ulcerogenic, and possessing characteristics that aid in wound healing [28, 29, 30].

Burns and blisters get treated with the seeds. Conversely, boiling seeds can act as a diuretic and an antidysenteric. In addition, the stings of scorpions can be managed with the juice from the stem and the leaves. *P. oleracea*' s buds and leaves can be used as an anti-hemorrhagic recognized [31].

6. Pharmacology

6.1 Anti-oxidant

Portulaca oleracea' s components, consisting of Gallo tannins, omega-3 fatty acids, ascorbic acid, -tocopherols, kaempferol, quercetin, and apigenin, are believed to be important for the crop's antioxidant qualities [8, 16, 32]. The aqueous extract significantly decreased hydrogen peroxide-induced oxidative DNA lesions in human lymphocytes, whereas the ethanolic extract had no effects, which may be related to the antioxidant constituents found in the aqueous extract, as shown by the single-cell gel electrophoresis assay (Comet assay), a simple, fast, and inexpensive method for measuring DNA strand breaks [33]. By changing blood and liver antioxidant enzyme activities, raising leptin/-actin and liver PPAR a/-actin, and suppressing p-PERK protein expression and FAS mRNA expression in the liver and spleen of mice, the aqueous extract inhibits oxidative damage carried on by a high-fat diet [9].

6.2 Anti-inflammatory activity

Pretreatment with an aqueous extract of *Portulaca oleracea* inhibits tumor necrosis factor- (TNF-) induced by intracellular reactive oxygen species (ROS) production and overexpression of the adhesion molecule between cells - (ICAM-) 1, vascular cell adhesion molecule (VCAM)-1 and E-selectin in human umbilical vein endothelial cells (HUVEC) in a dose-dependent manner. This extract also blocked the translocation of nuclear factor κB (NF-κB) p65 into the nucleus, binding of TNF-α-induced NF-κB, and degradation of the inhibitor molecule (IκB). In addition, inhibition of TNF-α-induced HL-60 cell adhesion to HUVECs and TNF-α-induced mRNA expression of interleukin-(IL-) 8 and the chemotactic protein Monocyte-(MCP-) 1 was also observed. The aqueous extract of *Portulaca oleracea* may also play an important role in suppressing the vascular inflammatory process involved in the development of atherosclerosis [5].

6.3 Antimicrobial activity

The herb's aqueous and ether extracts displayed anti-gram-negative bacterial activity. Using an automatic single-cell bioassay technique, the antifungal activity of *P. oleracea* extracts against the hyphal growth of various fungi has been evaluated in real time. Based on the dynamic hyphal growth response curves of the test fungus Aspergillus and Trichophyton and the yeast Candida, the antifungal activity of each fraction of *P. oleracea* was determined [34]. A crude sample generated by ethyl acetate extract displayed a specific and noticeable effectiveness against Trichophyton dermatophytes. *Bacillus subtilis* is prevented by the entire *P. oleracea* plant extracted in ethanol, while Rhizobium leguminosarum was inhibited by the plants extracted in chloroform, ethanol, and hexane. The species didn't show that it was antagonistic to *E. coli* [35].

Agar cup assay and filter disc processes were utilized to assess the fungitoxicity of aqueous and organic solvent extracts against *Aspergillus niger*, *Rhizopus artocarpi*, and *Fusarium* sp. While ethanol and chloroform extracts of the same crop restricted the growth of *Rhizopus artocarpi*, hexane and aqueous extracts of the herb showed antifungal activity against *Fusarium* sp [36].

A 70% methyl alcohol extract of *Portulaca oleracea* shows antibacterial activity against the Gram-positive strains *Staphylococcus aureus*, *Bacillus subtilis*, and *Streptococcus* fa with inhibition zones of 13, 14, and 15 mm, respectively, as well as antifungal activity against *Candida albicans* with an inhibition zone of 12 mm [1].

6.4 Wound healing activity

Mus musculus JVI-1 was used to investigate the preliminary wound healing capabilities of *P. oleracea*. To do this, single and numerous doses of freshly homogenized, crude aerial sections of *P. oleracea* were applied topically to the surface of the excision site in various amounts. The effect of the plant on wound healing has been evaluated using measurements of wound contraction and tensile strength. The results showed that *P. oleracea* accelerates wound healing by reducing the wound's surface area and improving its tensile strength. One dosage of 50 mg produced the strongest contraction, while two doses of 25 mg produced the second-strongest contraction. Tensile strength and healed area measurements matched each other [37].

6.5 Antiulcerogenic Activity

Portulaca oleracea aqueous and ethanolic extracts at 0.8 g/kg and 1.4 g/kg, respectively, may decrease the severity of HCl-induced stomach ulcers in a way comparable to the effect shown with sucralfate 0.1 g/kg. The aqueous extract (0.56 and 0.8 g/kg) and the ethanolic extract (0.8 and 1.4 g/kg) also reduce the inflammation caused by pure ethanol.

The oral and intraperitoneal care of both extracts increases the pH of the stomach juice in mice with pylorus ligation in a dose-dependent way. *Portulaca oleracea* has substantial potential as an effective therapeutic agent for gastrointestinal diseases as a result of its gastro protective function [7].

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