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A Comprehensive Review on Ethnobotany and Photochemistry of an Herbal Weed *Trianthema portulacastrum* L.

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Abstract

Trianthema portulacastrum Linn. (Aizoaceae) is a diffuse, prostrate, branched herb, upto 30-65 cm long weed. It is native of South Africa but widely found in tropical and subtropical countries like India, Sri Lanka, Baluchistan, West Asia, Africa and Tropical America. The plant is considered as a medicinal herb and mostly used in Indian traditional medicine system. The principal drug of the weed is ecdysterone and the other constituents are trianthenol, 3acetylaleuritolic acid, 5,2'dihydroxy7 methoxy6,8 dimethyl flavone and leptorumol. The plant attributed with analgesic, antipyretic, anti-inflammatory, and stomachic properties and used in asthma, bronchitis, jaundice and oedema. The plant used against throat troubles and as an anti-fungal agent. A decoction of the herb is used as a vermifuge and is useful in rheumatism. It is considered as an antidote to alcoholic poisoning. The fleshy nature of leaves makes them suitable for use as a wound-dressing.

Keywords: Ayurveda, Ecdysterone, Hepatoprotective, *Trianthema portulacastrum* Linn

Introduction

Weeds are generally herbs contain many drugs and rich source of many natural products such as alkaloids, tannins, flavanoids, volatile oils, resins, pigments etc. Weeds are playing crucial role in human health care systems viz., Ayurveda, Unani, Siddha, Homeopathy and Folk medicine. The most of the weed plants used by rural or local people have biologically active compounds that have been shown to be effective against specific diseases and disorders of human and livestock. Many weeds contain several chemical compounds that are potentially useful for medical science and support the pharmaceutical industry in India and all over the world. *Trianthema portulacastrum* L. is a weed plant of Aizoaceae (the fig-marigold family or ice plant family). It is known as Hand Qooqi in Arabic, Dewasapt in Persian, Salasabuni in Hindi and Horse purslane in English. It is an annual indigenous plant of South Africa and found in tropical and subtropical countries of the world and widely distributed in India, Sri Lanka, Baluchistan, West Asia, Africa and Tropical America (Kirtikar and Basu, 2003) [18]. In India and neighbouring countries, it is a serious weed during summer season in the major field crops such as pulses, cotton, sugarcane, direct seeded rice and maize. *Trianthema* comprises about 17 species and is closely related to *Sesuvium* and *Cypselea*. These three genera are thought to link the Aizoaceae to the Portulacaceae.

1. Scientific classification (Shivhare *et al.*, 2012) [19]

Kingdom	:	Plantae
Sub Kingdom	:	Tracheobionta
Division	:	Spermatophyta
Sub Division	:	Magnoliophyta
Class	:	Magnoliopsida
Sub class	:	Caryophyllidae
Order	:	Caryophyllales
Family	:	Aizoaceae
Genus	:	<i>Trianthema</i> Linnaeus
Species	:	<i>Trianthema portulacastrum</i> L.

2. Vernacular Names

Arabic	:	Hand Qooqi
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Bengali	: Sabuni/Gadabani	
Chinese	: Jia Hai Ma Chi	
English	: Horse purslane/Carpetweed/Giant pigweed	
Hindi	: Salasabuni/Sabuni/Vishakhapara/Lal-sabuni/Sanathi/ Svet-sabuni	
Kannada	: Muchchugoni/ Pasalaesoppu.	
Malayalam	: Pasalikeera	
Marathi	: Pundharighentuli	
Oriya	: Sweta Puruni	
Persian	: Dewasapt	
Punjabi	: Biskhapra/ Itsit	
Sanskrit	: Chiratika/ Dhanpatra/ Vishakha/ Shvetapunarnava/ Shvetamula/ Upothaki.	
Sindhi	: Narmah	
Spanish	: Verdolaga	
Tamil	: Sharunnai/Shavalai/Shaaranaj	
Telugu	: Ambatimadu/ Atikamamidi/ Galijeru.	
Unani	: Lotoos Aghryoos	
Urdu	: Biskhapra	

3. Taxonomic description

(Gamble *et al.*, 1967; Pullaiah and Chennaiah, 1997) [10, 24].

Synonym : *Trianthema monogyna* L. Mant.

Family : Aizoaceae

Annual or perennial herbs; leaves simple, often fleshy, opposite, alternate or falsely whorled; stipules scarious or 0; flowers regular, hermaphrodite or rarely polygamous, in cymes or fascicles, rarely solitary; calyx of 4-5, sepals free or rarely adnate to the ovary, usually persistent; petals usually 0, when present small; stamens perigynous or hypogynous, definite or indefinite, sometimes with staminodes; filaments free or connate; anthers oblong; ovary free, 2-5 celled, syncarpous or rarely apocarpous; ovules many in each carpel, axile or solitary basal; styles as many as the carpels; fruit usually capsular, dehiscent loculicidally or circumscissile, some times of indehiscent cocci; seeds many or 1 in each carpel, usually reniform, compressed; testa membranous or crustaceous, often pitted or tuberculate; curved or annular embryo.

Syncarpous fruit; Calyx tube elongate; Stamens inserted on the calyx tube;

Capsule circumsciss; Petals 0; Ovary and capsule 1-2 celled.....*Trianthema* Linn.

Leaves obovate; Flowers solitary, sessile, sheathed by the base of the petiole;

Style 1; stamens 10 or 15; Capsule top mitriform, enclosing at least 1 seed, the lower part 3-5 seeded; Seeds with concentric muriculate lines.....*Trianthema portulacastrum* Linn.

4. Morphology

Plants are diffuse, prostrate, branched herbs (Fig 1); glabrous or papillose; thickened and flattened at the nodes; Root- a taproot system with fibrous hairs; Stem - more or less angular, glabrous or pubescent, much branched; Leaves - petioled, opposite, unequal, one of the lower pair much smaller than the other (Fig 2); entire, sub-fleshy; leaf blade obovate to orbicular, or oblong, 1.5-3.5 × 1-3 cm, sub-succulent, purplish on margins, base cuneate, margin entire, apex obtuse, apiculate, petioles of each pair connected at the base by stipuliform membranous; Flowers - small, white or bright pink, axillary, solitary in pouch or between forks of branches (Fig 3); bracts membranous as are the 2 bracteoles; calyx tube short or long; lobes 5, coloured within, mucronate on the back near the tip; petals 0; stamens 5, 10, or 15, inserted near the top of the calyx-tube, filaments white, glabrous; Ovary free, sessile, usually truncate at apex, 1-2 celled; ovules 1 or more in each cell, from a basal placenta; styles 1 or 2, papillose. Fruit - a capsule, capsules circumscissile, glabrous, partly concealed in the petiolar hood; the upper part carrying away 1-2 seeds, the lower 2- many seeded. Flowering - June to October; Fruiting - July to December; Seeds are reniform, muriculate and dull black in colour with epigeal germination (Kirtikar and Basu, 2003) [18]. The production of flowers and seeds of *T. portulacastrum* starts 20 - 30 days after germination of the seeds. Enormous seeding capacity or very little dormancy allows the mature seed to germinate immediately thus, producing multiple generations in the same season. Cotyledons are elliptic and have epigeal germination. Seeds of *T. portulacastrum* germinate between 20- 45 °C, with an optimum at 35 °C. More than 50% of fresh seeds germinate within 4-8 days of incubation.



Fig 1: Profuse growth of *Trianthema portulacastrum* L.



Fig 2: Branch of mature plant of *T. portulacastrum*



Fig 3: White colored flowering of *T. portulacastrum*

5. Anatomy

Mature root shows anomalous secondary growth; cork 5 to 8 layered; secondary cortex narrow zone consisting of round to polygonal, tangentially elongated, thin-walled, parenchymatous cells; a few cells containing groups of prismatic crystals of calcium oxalate; below secondary cortex five concentric bands of vascular tissue; vessels of varying sizes occurring along with xylem fibres and phloem; phloem composed of thin walled cells having intercellular spaces, a few cells containing prismatic crystals of calcium oxalate; a few rows of polygonal, thin walled, parenchymatous cells occur in rings; medullary rays prominent in middle of the cortical region and in the second or third vascular bundle ring; centre mostly occupied by a single vascular bundle strand with two isolated groups of phloem (Anonymous, 2007) [2].

6. Economic importance

In India and other South-East Asian countries, *T. portulacastrum* is commonly used in vegetable dishes during

the rainy seasons when it grows abundantly. In Africa, especially Ghana and Tanzania, the young leaves of the plant are consumed as cooked vegetables or in soups (Jansen, 2004) [12]. Recent study showed nutritional potential of this wild edible plant as it represents a good source of fiber, proteins, riboflavin, potassium, sodium and iron (Khan *et al.*, 2013) [16]. Leaves of *T. portulacastrum* used in cure of dropsy, edema and ascites. Decoction of the herb used as an antidote in alcohol poisoning, also used in rheumatism and as a vermifuge. It is also used as alternative cure for bronchitis, heart disease, anaemia, inflammation and piles (Ambasta, 1986; Kirtikar and Basu, 2003) [1, 18]. However, the plant may cause diarrhoea or paralysis, particularly when older leaves are eaten. Moreover, the fodder (foliage of the weed) can produce similar effects on domestic animals, because of this deadly effect most animals are refused to eat. The seeds are harmful contaminants in food grains and other crop seeds. The plant has a potential value as a source of organic matter. In Africa, Philippines, Thailand and India roots of horse purslane are

used to relieve obstructions of the liver and to relieve asthma. The leaves are diuretic and are applied in the treatment of edema, jaundice, painful discharge of urine and dropsy. A decoction of the herb is used as a vermifuge and also utilized for the cure of rheumatism. And it is considered as an antidote to alcoholic poisoning. The fleshy nature of the leaves makes them suitable for use as a wound-dressing or bandage.

7. Ethnomedicinal properties

T. portulacastrum widely used in Ayurvedic, Siddha and Folk medicine (Table 1). Different parts of the herb are traditionally used as analgesic, stomachic, laxative, treatment of blood disease, anaemia, inflammation, and night blindness. The plant is alexiteric, analgesic, stomachic and laxative and cures bronchitis, piles, ascites and heart diseases. Decoction of the plant is used as vermifuge and cure of rheumatism. Powdered root is abortifacient and cathartic and used in asthma, amenorrhoea and to remove obstruction of the liver. The leaves are diuretic and used in oedema, dropsy and ascites. Laboratory investigations on extracts of the plant have demonstrated significant pharmacological activities, such as antioxidant, diuretic, analgesic, hepatoprotective, and

anticarcinogenic. The plant has been used in the indigenous system of medicine for the obstruction of the liver asthma, amenorrhoea, dropsy, edema, ascites, and beriberi. The plant cures “Kapha” bronchitis, heart diseases of the blood, anemia, inflammations, “Vata” piles and ascites. A decoction of the herb is used as a vermifuge and is useful in rheumatism. It is also an antidote to alcoholic person (Kirtikar and Basu, 2003) [18].

Root- Antipyretic, analgesic, spasmolytic, deobstruent, and anti-inflammatory. The ayurvedic pharmacopoeia of India recommended this herb in diseases of liver and spleen, anemia, and edema. The root applied to the eye to cures corneal ulcers, itching, dimness of sight, and night blindness. The root is cathartic and abortifacient with irritant properties. An infusion of the roots is administered in jaundice, stranguary and dropsy. The powdered bitter and nauseous root is given in combination with ginger as a cathartic. In the Philippine Islands the powdered root is given as a cathartic. Leaves- Used as diuretic in edema and dropsy. A decoction of the herb is used as an antidote to alcoholic poison. Leaves have been reported to be diuretic, and therefore useful in the treatment of edema and ascites (Kirtikar and Basu, 2003; Khare, 2006) [18, 17].

Table 1: Ethnomedicinal properties of *Trianthema portulacastrum* L.

Nature	alexiteric, analgesic, stomachic and laxative, antioxidant, diuretic, hepatoprotective, and anticarcinogenic.		
Ayurvedic Properties	Rasa (Taste)	–	Tikta (bitter)
	Virya (Potency)	–	Ushan (hot)
	Dosa Nidan (Treatment)	–	Kapha, Vata
Dosage	Leaves	:	2– 5 gm powder
Treatment	Decoction	:	20–30 gm of the drug
	Cures “Kapha,” bronchitis, “Vata,” piles and ascites Decoction - an antidote to alcoholic person.		
Medicinal value:	This herb was used in treatment of blood disease, anemia, inflammation, night blindness, bronchitis, piles, ascites, rheumatism, inflammations and heart diseases.		
	Decoction	– used as vermifuge, rheumatism.	
	Powdered root	– abortifacient and cathartic;	
	Powdered root	– used in asthma and amenorrhoea, liver.	
	Leaves	– diuretic, used in oedema, dropsy and ascites.	
Root	– Antipyretic, analgesic, spasmolytic, deobstruent, anti-inflammatory; applied to the eye cures corneal ulcers, itching, dimness of sight, and night blindness.		

8. Photochemistry

Photochemical screening has revealed the presence of alkaloids, steroids, flavonoid, tannins, terpenoids, glycosides, flavonoids, phenolic compounds, fats, carbohydrates water soluble bases and potassium salts (Table 2). Punarnavine and a new alkaloid, trianthemine and ecdysterone are present in the aerial parts. Roots contain saponin glycoside. The principal constituent of *T. portulacastrum* is ecdysterone and the other constituents are trianthemol, 3acetylaleuritolic acid, 5,2’ dihydroxy 7 methoxy 6,8 dimethyl flavone, leptorumol, 3,4dimethoxy cinnamic acid, 5hydroxy2 methoxy benzaldehyde, pmethoxy benzoic acid, and betacyanin. The red and white flowers contain an alkaloid trianthemine, also

punarnavine. The plant contains nicotinic acid (Vitamin B), ascorbic acid (Vitamin C). The mineral profile of *T. portulacastrum* was reported as calcium (0.3%), magnesium (0.2%), iron (50 ppm), copper (8 ppm), zinc (30.0 ppm), and manganese (50 ppm), whereas the phosphorus content at 0.13% ± 0.1% and crude protein 1.5% ± 1.2%. The plant is rich in phosphorous and iron but poor in calcium. The high content of oxalate affects the assimilation of calcium. Carotene (2.3 mg/100 g) has also been reported (Kirtikar and Basu, 1975; Vohora *et al.*, 1983; Bishayee *et al.*, 1996; Udom *et al.*, 1997; Javed *et al.*, 2000; Jansen, 2004; Khare, 2006; Bharathidhasan *et al.*, 2007; Shivhare *et al.*, 2012; Khan *et al.*, 2013) [19, 33, 7, 32, 13, 12, 17, 29, 16].

Table 2: Phytochemical properties *Trianthema portulacastrum* L.

Compounds	Photochemical screening has revealed the presence of steroids, alkaloids, terpenoids, glycosides, flavonoids, tannins, phenolic compounds, fats, and carbohydrates.
Nutritive value:	Crude proteins - 21.5% ± 1.2% Calcium - 0.3% Magnesium - 0.2% Iron - 50 ppm Copper - 8 ppm Zinc - 30.0 ppm Manganese - 50 ppm Nicotinic acid - (Vitamin B) Ascorbic acid - (Vitamin C) The plant is rich in phosphorous and iron but poor in calcium
Principle constituents	Punarnavine, Trianthenol, Triantheme and Ecdysterone - Aerial parts Oxalic acid, 5,2dihydroxy7methoxy6,8dimethylflavone 5,7dihydroxy6,8dimethylchromone(leptorumol) Saponin glycoside - Roots Quercetin and ferulic acid - Fungus affected plants 3,4dimethoxy cinnamic acid, 5hydroxy2methoxybenzaldehyde, p methoxybenzoic acid, Triantheme and punarnavine - The red and white flowers Ecdysterone - Most widely occurring phytoecdysone Hydrocarbons- - Surface wax of the fresh leaves Betacyanin and 3,4dimethoxy cinnamic acid
Biological activities	Tetraterpenoid and Trianthenol - Antifungal activity Chloroform extract - Antifungal activity Ecdysterone - Chemosterilant The ethanol extract of whole plant - Analgesic activity The methanolic extract - Antihyperglycemic activity The methanolic extract of whole plant - Hypolipidemic activity The chloroform extract - Anticarcinogenic activity The ethanolic leaves extract - Hepatoprotective activity The ethanolic leaves extract - Antioxidant activity

8.1. Extraction of airdried plant

Extraction of airdried plant with dichloromethane has led to the isolation of a new flavonoid, 5, 2' dihydroxy 7methoxy 6,8 dimethyl flavone (C methylflavone), along with 5,7dihydroxy6,8dimethylchromone (leptorumol), which has been previously reported from a fern species (Ibn Sina, 2007; Sharmila *et al.*, 2009) [11, 28].

8.2. Chromatography

Chromatography of dried plant with methylene chloride on silica yielded long chain esters, a mixture of C₁₄, C₁₆, C₁₈, C₂₀, and C₂₂ long chain alcohols; β sitosterol, stigmasterol, and their β glucopyranosides (Ibn Sina, 2007) [11].

8.3. Chloroform extract

A tetraterpenoid named trianthenol has been isolated from the chloroform extract of the plant. Its structure was established as 15 hydroxymethyl 2, 6, 10, 18, 22, 26, 30 heptamethyl 14 methylene 17 hentriacontene on the basis of spectroscopic data, including high resolution mass and two dimensional Nuclear Magnetic Resonance (NMR) techniques. Ecdysterone has been isolated from the whole plant which is the most widely occurring phytoecdysone (Ibn Sina, 2007; Karim *et al.*, 2011) [11, 14].

8.4. Gas liquid chromatography

Hydrocarbons from the surface wax of the fresh leaves of plant have been isolated and characterized and their relative distribution determined through gas liquid chromatography studies. Betacyanin and 3,4dimethoxy cinnamic acid also have been reported from *T. portulacastrum* and other aizoaceae family. Four new compounds first time reported from *T. portulacastrum* as 5hydroxy2methoxybenzaldehyde, 3acetylaleuritic acid, p methoxybenzoic acid, and ppropoxybenzoic acid (Karnick, 1970; Banerji, 1971; Ibn Sina, 2007) [15, 11, 4].

9. Pharmacological/Biological Activities

9.1. Antifungal activity

Tetraterpenoid trianthenol and chloroform extract of plant both showed antifungal activity (Nawaz *et al.*, 2001) [23].

9.2. Chemosterilant/molting hormone activity

Ecdysterone is the most widely occurring phytoecdysone, is also obtained from whole plant of *T. portulacastrum* as a major chemical constituent. The compound and its analogs have potential use as chemosterilants (Ravishankar and Mehta, 1979; Dinan, 2001) [25, 19].

9.3. Analgesic activity/antinociceptive activity

The ethanol extract of *T. portulacastrum* (whole plant) was evaluated to assess analgesic activity. The extract showed significant antinociceptive action in mice (Shanmugam, 2007) [27].

9.4. Antihyperglycemic activity/hypoglycaemic

The methanolic extract of *T. portulacastrum* whole plant produced significant antihyperglycemic activity against streptozotocin (STZ) induced diabetic rats (Sundera, 2009) [31].

9.5. Hypolipidemic activity

The methanolic extract of whole plant produced a dose dependent hypolipidemic activity in rats (Anreddy *et al.*, 2010) [3].

9.6. Anticarcinogenic activity

The study the anticarcinogenic property of *T. portulacastrum* is very promising. The chloroform fraction of overground part of the plant has emerged as the most active fraction inhibiting chemically induced rat hepatocarcinogenesis (Bhattacharya and Chatterjee, 1998) [6].

9.7. Hepatoprotective activity

The ethanolic leaves extract of *T. portulacastrum* showed a significant dose-dependent (100 mg and 200 mg/kg p.o.) hepatoprotective protective effect against two well-known hepatotoxins namely paracetamol and thioacetamide induced hepatotoxicity in albino rats (Mandal *et al.*, 1997; Bhattacharya and Chatterjee, 1998; Kumar *et al.*, 2004; Shyam *et al.*, 2010) [22, 6, 20, 30].

9.8. Antioxidant activity

The ethanolic leaves extract of *T. portulacastrum* showed the antioxidant activity in relation to hepatotoxins, paracetamol and thioacetamide in rats (Sarkar *et al.*, 1999; Kumar *et al.*, 2005) [26, 21].

9.9. Anti Glomerulosclerosis

The methanolic extract of *T. portulacastrum* with 100 and 200 mg/kg produced a protection against atherosclerotic diet or CCT (4% cholesterol, 1% cholic acid, and 0.5% thiouracil) diet-induced glomerulosclerosis and hepatic damage in rats (Shyam *et al.*, 2010) [30].

Conclusion

Trianthema portulacastrum, a medicinal and dietary plant used as a valuable herb in the Indian traditional medicinal system, such as Ayurvedic medicine and used as analgesic, stomachic, laxative, and serves as alterative cure for bronchitis, heart disease and anaemia. Trianthenol, ecdysterone and leptorumol are various phytochemicals which has been isolated from this plant. The weed plant has gained substantial importance due to its various pharmacological properties including anti-inflammatory, antioxidant, antipyretic, hypoglycaemic, hepatoprotective and anticarcinogenic activities. Several anatomical parts of *T. portulacastrum* are traditionally used for the treatment of alcohol poisoning, anemia, ascites, asthma, beri-beri, bronchitis, corneal ulcers, dropsy, edema, heart diseases, inflammation, liver ailments, migraine, night

blindness, piles and rheumatism. The weed *Trianthema portulacastrum* considered and widely used in Indian Medicinal Systems since the few decades. The plant attracted researchers and scientists with its several chemical properties and the intensive research is essential towards this herb.

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