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Physicochemical, Phytochemical and Pharmacognostic Evaluation of a Halophytic Plant, *Trianthema portulacastrum* L.

Pande Jyoti, Kanakiya Ankita, Padalia Hemali and Chanda Sumitra*

Phytochemical, Pharmacological and Microbiological laboratory, Department of Biosciences (UGC-CAS), Saurashtra University, Rajkot-360005, India

**Corresponding author*

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A B S T R A C T

Trianthema portulacastrum L. belongs to the family Aizoaceae. It is an important medicinal halophyte, traditionally used to cure many diseases and disorders. It order to ensure authenticity and maintain the therapeutic efficacy of this plant, evaluation of certain quality control parameters for the standardization of this plant was attempted. To achieve this, physicochemical, phytochemical and pharmacognostic studies of this plant was done. For phytochemical analysis, phenols, flavonoids, cardiac glycosides, tannins, steroids, saponins, triterpenes, coumarins, phlobatanins, etc. were evaluated. For physicochemical analysis, loss on drying, total ash, water soluble, acid insoluble, sulphated, nitrated and carbonated ash were determined. The extractive values in different polar and non-polar solvents were measured. Finally macroscopic, microscopic and powder study of leaf and stem was done. All the standard methods were followed for different estimations. The crude powder of *T. portulacastrum* was rich in coumarins; while its solvent extracts toluene and ethylacetate were rich in steroids. In physicochemical analysis loss on drying was 9.5%. The ash values ranged from 0.83% to 11.83%. The extractive values of organic solvents ranged from 0.52% to 8.64% and water soluble extractive value was 17.74%. Maximum extractive value was in methanol and water indicating presence of more polar compounds than nonpolar compounds. The macroscopic, microscopic and powder characteristics of leaf and stem was measured. The parameters evaluated in this study will safeguard the authenticity and efficacy of crude drug and also distinguish the drug from its adulterants. The parameters enlisted in this study will be useful and helpful in setting diagnostic indices for identification and preparation of monograph of this plant

Introduction

The practice of traditional medicine is based on hundreds of years of belief and observations and analysis, which help in the development of modern medicine. Today interest in herbal drugs is increasing primarily based upon the idea that herbal medicines are safe, inexpensive and have less adverse effects. Each plant drug possesses unique properties in terms of its botany, chemical constituents and therapeutic potency. In folkloric medicine, plants are used for curing various diseases mainly based on popular belief passed on from generation to generation. For *e.g. Costus pictus*, known as 'insulin plant', a member of Costaceae family is used as a munching dietary supplement for

the treatment of diabetes in Southern India (Jayasri *et al.,* 2008). *Enicostema littorale* is another herb of family Gentianaceae used for hypoglycemic activity found in many parts of India such as Gujarat and Maharashtra (Maroo *et al.,* 2003). The only shortcoming of traditional medicine is there are no stringent quality control parameters; in other words, there are no standardization parameters and hence they are prone to adulteration and substitution and puts doubt on their efficacy. Their chance of getting adulterated is directly proportional to their efficacy and availability. So it is important to study pharmacognostic characters of each medicinal plant to differentiate the unadulterated plant sample.

Among the medicinal plants, halophytic plants are very significant. Halophytic vegetation dominates the tidal marsh ecosystems. Plants develop specific anatomical, morphological, and physiological characteristics enabling them to perform their vital functions in the presence of large concentrations of harmful salts. The ability of some of the halophytes to resist high salt conditions is because of two main mechanisms either they exclude the salt well in leaves (salt exclusion) or compartmentalize. Most of the medicinal halophyte plants are herbs and forbs and are perennial and their biological types were therophyte and chameophyte (Priyashree *et al.,* 2010).

Trianthema portulacastrum L. belongs to the family Aizoaceae, commonly known as noxious weed, horse purslane, hogweed, itcit or santha. It is a prostrate, glabrous, succulent herb found almost throughout India in cultivated and wastelands. The plant is bitter, alexiteric, analgesic, stomachic, laxative. It has been reported for some traditional use as anthelmintic, vermifuge and antirhematitis (Shastri, 1952) and serves as alterative cure for bronchitis, heart disease, blood anaemia, inflammation, and piles, ascites. The root applied to the eye cures corneal ulcers, itching, dimness of sight and night blindness (Kirtikar and Basu, 1933). It is also used as vegetable in various parts of world due to its high nutritional value. Two forms are reported of this plant, a red coloured form in which the stem, leaf margin and flowers are red; and a green coloured form which has a green stem and white flowers. The leaves possess diuretic properties (Balamurugan *et al.,* 2009). The plant shows hepatoprotective (Kumar *et al.,* 2004) and antioxidant activity (Sunder *et al.,* 2010).

In the present study, an attempt has been done to lay down some standardization parameters for *Trianthema portulacastrum* leaf and stem. Hence the objectives of the study were to evaluate organoleptic features, macroscopic and microscopic evaluation of *T. portulacastrum* leaf and stem. The whole plant dry powder was evaluated for its phytochemical, physicochemical and fluorescence analysis.

Materials and Methods

Plant collection

The halophytic plant *Trianthema portulacastrum* L. was collected in August, 2017 from Porbandar, Gujarat, India. The plant was washed thoroughly was tap water, shade dried and homogenized to fine powder and stored in closed container for further studies.

Pharmacognostic study

Macroscopic study

The macroscopic studies were carried out using organoleptic evaluation method. The arrangement, size, shape, base, texture, margin, apex, veination, colour, odour, taste of leaves and stem were observed. Macroscopic

and microscopic characters were studied as described in quality control method (Khandelwal, 2008). Photographs at different magnifications were taken by using digital camera.

Microscopic study

Microscopic study was carried out by preparing thin sections of stem and leaf. The thin sections were further washed with water, stained with safranin, fast green and mounted in glycerine for observation and confirm its lignifications (10x, 40x) (Tyler *et al.,* 1977).

Powder microscopy

The powder microscopy of the whole plant powder was studied using standard procedure by capturing the images of different fragments of tissues and diagnostic characteristic features were recorded (Tyler *et al.,* 1977).

Physicochemical analysis

The physicochemical parameters like loss on drying, total ash, acid-insoluble ash, water-soluble ash, sulphated ash and extractive values were determined as per WHO guidelines (WHO, 1998).

The solvents used were petroleum ether (PE), toluene (TO), ethyl acetate (EA), methanol (ME) and water (AQ). The details of the procedure followed are as described earlier (Pande and Chanda, 2017).

Phytochemical analysis

The qualitative phytochemical analysis of crude powder and different solvent extracts of whole plant powder and different solvent extracts of *Trianthema portulacastrum* was carried out to identify different phytoconstitutents (Harbone, 1998). The phytoconstituents analysed were alkaloids, flavonoids, phenols, saponins, tannins, cardiac glycosides, steroids, phlobatanins, triterpenes, anthocyanins, etc. The presence of specific phytochemicals indicated is indicated with (+) sign and the absence of phytochemicals is indicated with (-) sign. The procedure followed for different phytochemical analysis is given Table 1.

Fluorescence analysis

Fluorescence study of different plants powder was performed as per Chase and Pratt (1949). A small quantity of the plants powder was placed on a grease free clean microscopic slide and 1-2 drops of freshly prepared reagent solution were added, mixed by gentle tilting of the slide and waited for a few minutes. Then the slide was placed inside the UV chamber and observed in visible light, short (254 nm) and long (365nm) ultra violet radiations. The colours observed by application of different reagents in different radiations were recorded.

Results and Discussion

Organoleptic and macroscopic characteristic of *Trianthema portulacastrum* L.

T. portulacastrum is a prostrate, sub-succulent herb and facultative halophyte. The organoleptic and macroscopic characteristics of the plant are given in Table 2 and Figure 1.

Leaves

The leaf was simple, green in colour, phyllotaxy was obliquely opposite, shape was obovate, margin was entire, apex was apicular, base was asymmetrical, veination was reticulate, petiole was long. Outer surface was smooth and fleshy. The odour was characteristic and taste was bitter. The average size of leaf was 5-6 cm length and 2-4 cm wide (Fig. 1a and Table 2).

Stem

The stem was light pink in colour, branched, woody, prostrate. Outer surface was glabrous. The average size of the stem was 10 cm long and 0.2-0.5 cm thick (Fig. 1b and Table 2).

Microscopic characteristic

Petiole

The transverse section of *T. portulacastrum* petiole is shown in Figure 2. The petiole was bean shaped. The single layered upper and lower epidermis was surrounded by thin cuticle layer (Fig. 2a).

The epidermis was covered with unicellular and multicellular, 2-3 celled trichomes. Ground tissue was parenchymatous, vascular bundles were three in numbers, the size of the vascular bundles varied from centre to leaf margin i.e. large too small. They were centripetal arranged i.e. xylem surrounded by the phloem (Fig. 2b).

Leaf

The transverse section of *T. portulacastrum* leaf is shown in Figure 2. The leaf lamina was dorsiventral in nature. The upper epidermis and lower epidermis were single layered. The palisade tissue was single layered on the upper surface, it was covered with thick cuticle (Fig. 2c). The lower surface of leaf showed unicellular trichomes. The mesophyll was small, consisted of 4-7 layered. T.S. passing through the mid rib region showed vascular bundles towards the ventral surface and it was surrounded by palisade tissues (Fig. 2d). Centrally located conjoint collateral vascular bundles were surrounded by spongy parenchymatous cells. The xylem was surrounded by phloem (Fig. 2e). The paracytic stomata were present in lower epidermis (Fig. 2f).

Stem

The transverse section of *T. portulacastrum* stem is shown in Figure 3. The epidermis was single layered thick walled, narrow, small and it was surrounded by thick cuticle layer (Fig. 3a). The unicellular and multicellular trichomes were present on the outer surface of the epidermis. The cortex region consisted of 6-8 layers (Fig. 3b). The vascular bundles were present in the pith region. The plant showed secondary growth, phloem was present below the xylem (Fig. 3c).

The vascular bundles were surrounded by polygonal parenchymatous cells, vascular bundles were conjoint, collateral, close type, arranged in a ring form (Fig. 3d). The vascular bundles were eight to ten in number without cambium ring, pith was made up of well-developed parenchymatous tissue (Fig. 3e). The xylem was well developed and consisted of vessels, fibres, metaxylem and xylem parenchyma. Phloem consisted of sieve tubes, companion cells and phloem parenchyma (Fig. 3f).

Powder microscopy of the plant

The crude powder of the *T. portulacastrum* plant was green in colour, taste was bitter and odour was characteristic. The powder microscopic characteristics are shown in Figure 4. The specific characteristics of powder determined by microscopic investigation showed unicellular trichomes, multicellular trichomes, spiral vessels, annual vessels, bordered pitted vessels, pitted vessels, paracytic stomata, sclerenchymatous cells, etc.

Physicochemical analysis

The physicochemical analysis of *T. portulacastrum* plant is given in Figure 5 and 6. The loss on drying of dry powder of plant was 9.5%.

Table.1 Phytochemical analysis

No.	Phytochemicals	Test	Observation
1	Alkaloids	Add crude powder and solvent extracts to 2N HCl and mixture was filtrated. 1) The filtrate was treated with few drops of Dragondroff 's reagent 2) The filtrate was treated with few drops of Mayer's reagent. 3) The filtrate was treated with few drops of Wagner's reagent	 Formation of orange precipitate indicated the presence of alkaloids. Formation of Cream precipitate indicated the presence of alkaloids. Formation of brown precipitate indicated the presence of alkaloids.
2	Phenols	The crude powder and solvent extracts was dissolved in distilled water. It was filtered the filtrate was treated with a few drops of 5% $FeCl_3$solution	Formation of deep blue colour indicated the presence of phenols
3	Flavonoids	The crude powder and solvent extracts was dissolved in distilled water. It was filtered the filtrate was treated with a few drops of diluted NaOH, again add few drops of diluted HCl	Formation of yellow orange colour to colourless indicated the presence of flavonoids
4	Saponins (Frothing test)	The crude powder and solvent extracts of different plants was vigorously shaken with distilled water and allowed to stand for 10 min.	Stable formation of froth for 1 min indicated presence of saponins
5	Tannins ($FeCl_3$ test)	The crude powder and solvent extracts of different plants was dissolved in distilled water. It was filtered and the filtrate was treated with alcoholic ferric chloride ($FeCl_3$) reagent	Formation of blue colour indicated the presence of tannins
6	Steroids (Liebennann – Burchard test)	The crude powder and solvent extracts of different plants was dissolved in chloroform. It was filtered and the filtered chloroform extract was treated with acetic anhydride and a few drops of concentrated H_2SO_4	Formation of blue green ring indicated the presence of steroids
7	Phlobatanins	The crude powder and solvent extracts of different plants was boiled with 1% aqueous HCl	Formation of red precipitate indicated the presence of phlobatannins
8	Anthocyanins	The crude powder and solvent extracts of different plants was dissolved in methanol. It was filtered and the filtered methanolic extract was treated with 2.0 ml NaOH (1 N)	The colour of the solution changed to blue indicated the presence of anthocyanins
9	Triterpenes	The crude powder and solvent extracts of different plants was dissolved in chloroform. It was filtered and the	Formation of reddish brown ring indicated the presence of triterpens

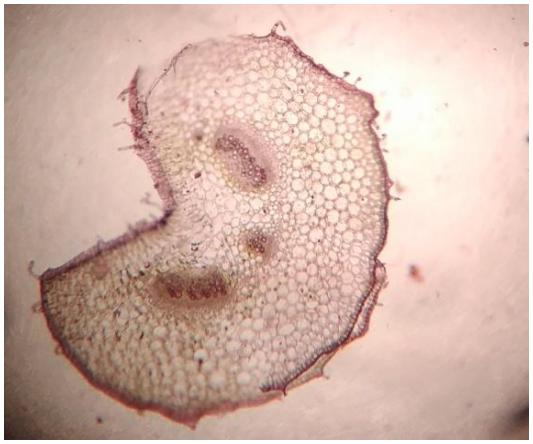
		filtered chloroform extract was treated with concentrated H_2SO_4	
10	Cardiac Glycosides (Keller – Kiliani test)	The crude powder and solvent extracts of different plants was dissolved in distilled water. It was filtered and the filtered aqueous extract was treated with 1.0 ml mixture of 5 % $FeCl_3$ and glacial acetic acid (1.99 V/V). To this solution, few drops of concentrated H_2SO_4 was added	Appearance of greenish blue colour within few minutes indicated the presence of cardiac glycosides
11	Coumarins	The crude powder and solvent extracts of different plants was dissolved in distilled water. It was filtered and the filtered aqueous extract was treated with 10 % NaOH	Formation of yellow colour of the solution indicated the presence of coumarins.
12	Leucoanthocyanins	The crude powder and solvent extracts of different plants was dissolved in distilled water. It was filtered and the filtered aqueous extract was treated with isoamyl alcohol in equal proportion.	Appearance of red colour in upper layer indicated the presence of leucoanthocyanins
13	Quinones	The crude powder and solvent extracts of different plants was dissolved in methanol. It was filtered and the filtered methanolic extract was treated with HCl	Formation of yellow precipitation indicated the presence of quinones

Fig.1 Macroscopic study of *Trianthema portulacastrum* L.

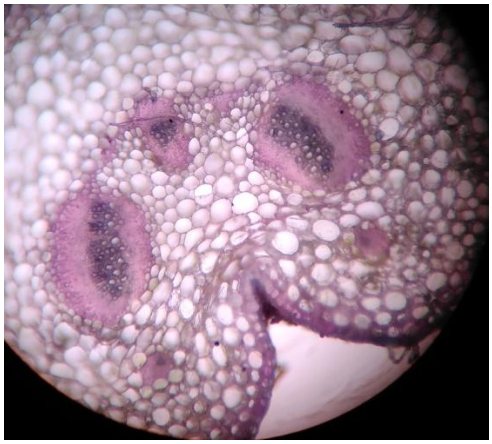
a) Leaf with petiole

b) Stem

Fig.2 Microscopic study of leaf of *T. portulacastrum*

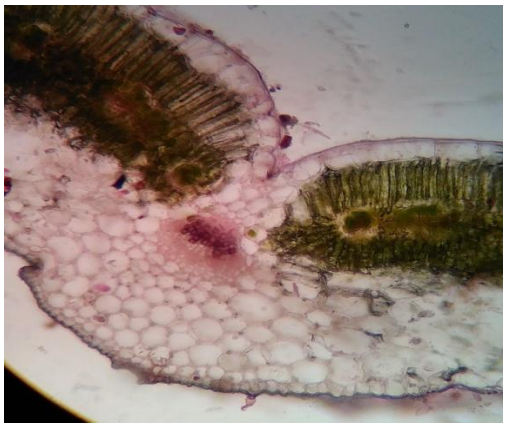


a) T.S. of petiole

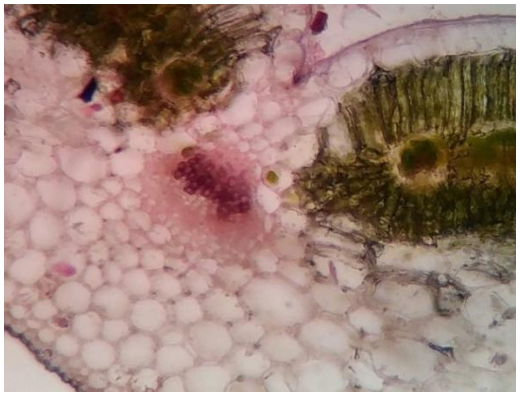


b) T.S of petiole with vascular bundles

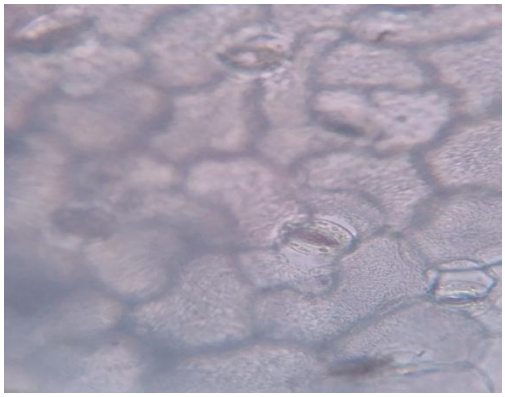
c) T.S. of leaf with epidermis



d) T.S. of leaf with palisade cells

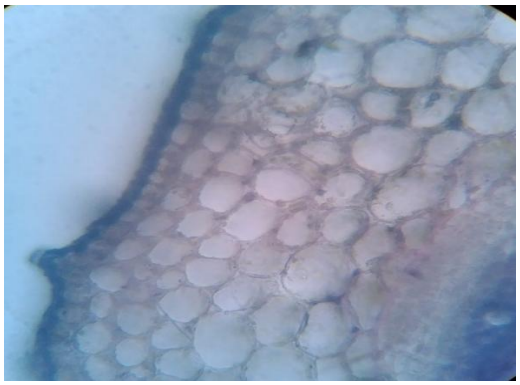


e) T.S. of leaf with vascular bundles

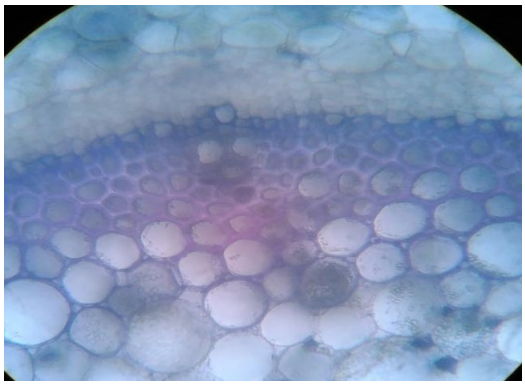


f) Paracytic stomata

Fig.3 Microscopic study of stem of *T. portulacastrum*

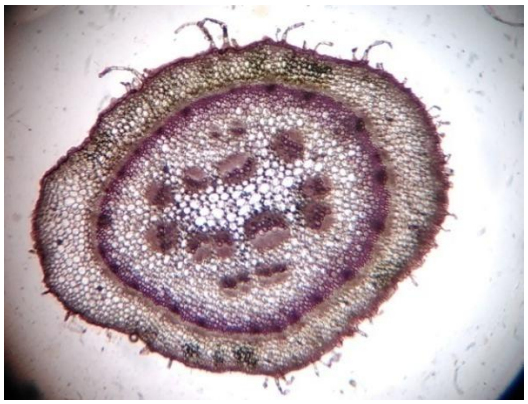


a) T.S. of stem with epidermis

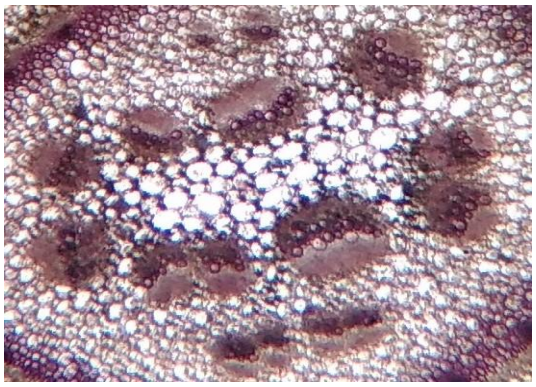


b) T.S. of stem with annual ring

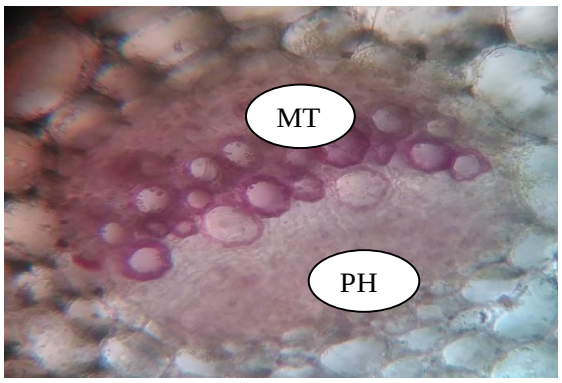
c) T.S. of stem with trichomes



d) T.S. of whole stem

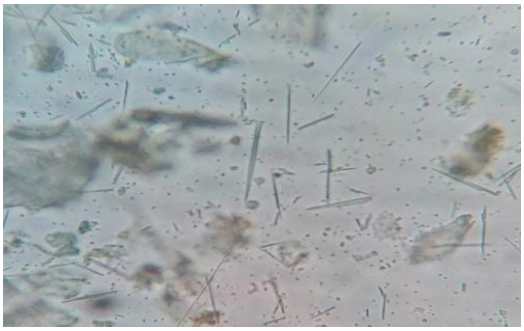


e) T.S. of stem with vascular bundles

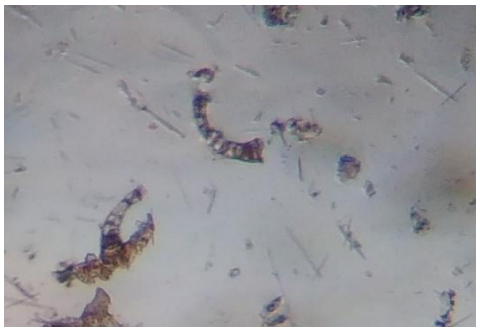


f) T.S. of stem with metaxylem and phloem

Fig.4 Powder study of *T. portulacastrum*

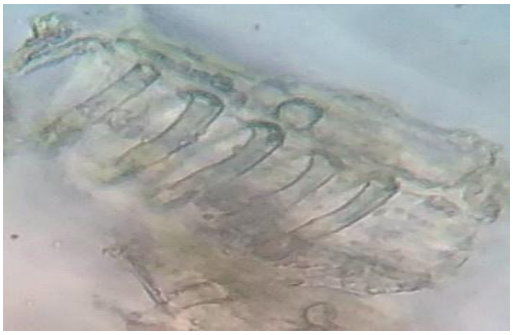


a) Unicellular trichomes

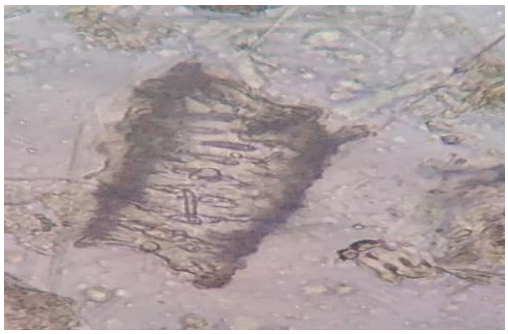


b) Multicellular trichomes

c) Spiral vessels

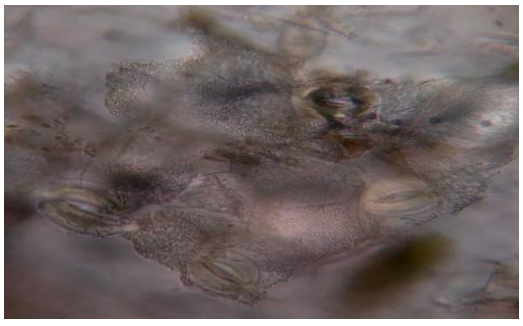


d) Annular vessels

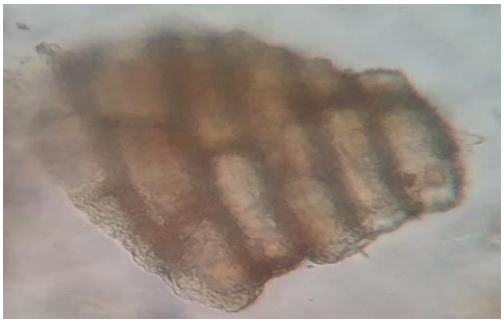


e) Bordered pitted vessels

f) Pitted vessels



g) Paracytic stomata



h) Sclerenchymatous cells

Fig.5 Ash values of crude powder of *T. portulacastrum*

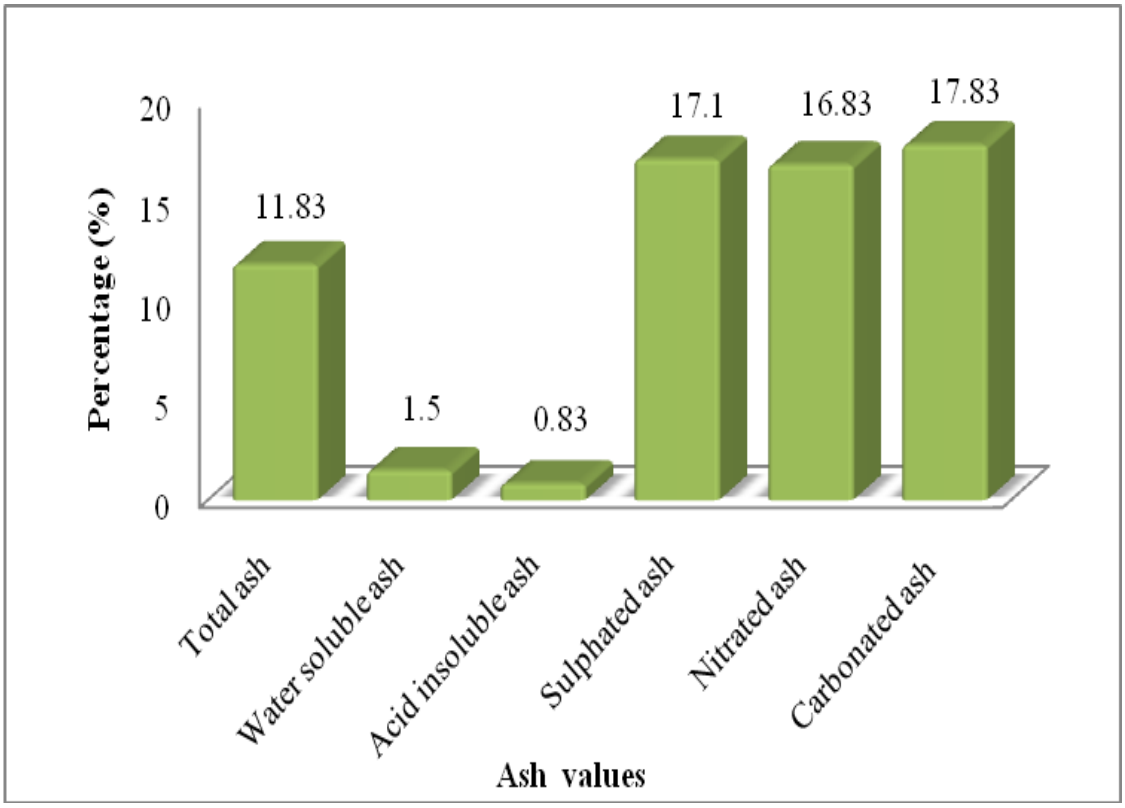


Fig.6 Extractive values of *T. portulacastrum* in different solvents

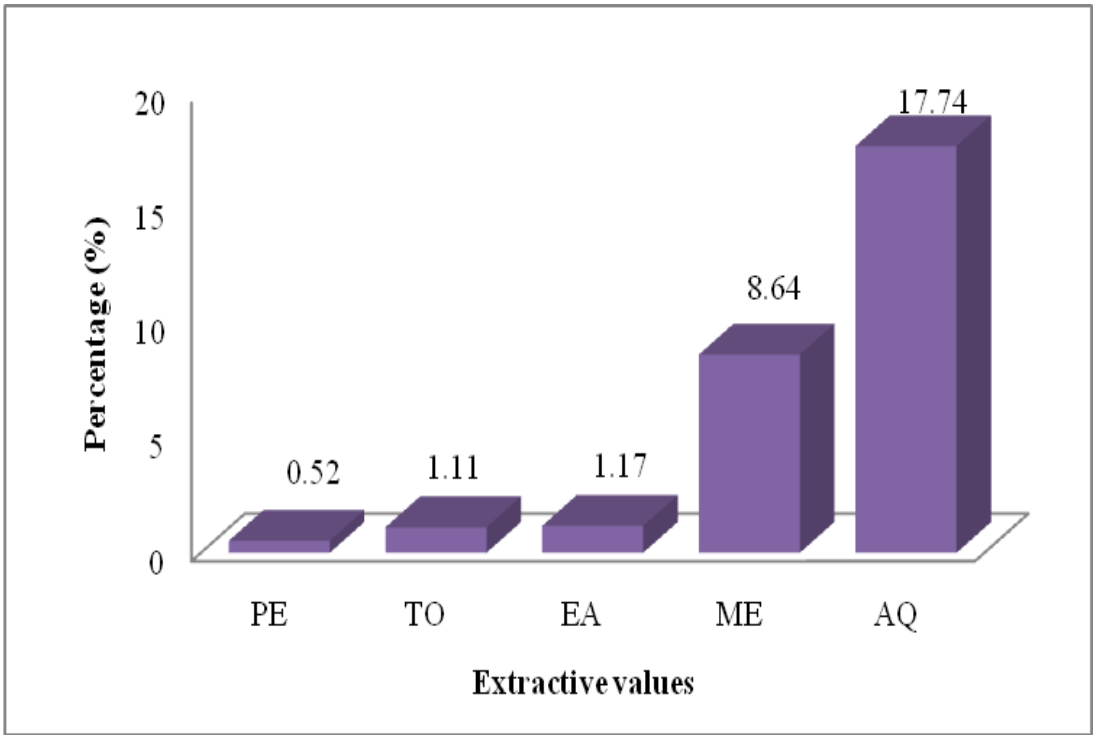


Table.2 Organoleptic features of *T. portulacastrum*

Characters	Observation	
Part	Leaves	Stem
Arrangement	Opposite	-
Size	5-6 cm length and 2 -4 cm wide	10 cm long and 0.2-0.5 cm thick
Shape	Obovate	-
Color	Green	Light pink
Odour	Characteristic	Characteristic
Taste	Bitter	Bitter
Appearance	Sub fleshy	Woody
Margin	Entire	-
Apex	Apicular	-
Base	Cunate	-
Petiole	Long	-
Texture	Glabrous	Glabrous
Veination	Reticulate	-
Outer surface	Smooth and fleshy	Light pink colour and glabrous surface

Table.3 Qualitative phytochemical analysis of *T. portulacastrum* plant

Sr. No	Phytochemicals	Whole plant					
		Crude powder	Different solvent extracts				
			PE	TO	EA	ME	AQ
1	**Alkaloids**						
	(1)Mayer's reagent	-	-	-	-	-	-
	(2)Dragondroff's reagent	+	-	-	-	-	++
	(3)Wagner's reagent	-	+	+	-	++	-
2	**Flavonoids**	+	-	+	+	+	+
3	**Tannins**	+	-	-	-	++	-
4	**Phlobatanins**	-	-	-	-	-	-
5	**Saponins**	++	+	+	+	-	++
6	**Steroids**	+	++	+++	+++	++	-
7	**Cardiac glycosides**	+	-	-	-	-	-
8	**Triterpenes**	+	-	-	+	++	-
9	**Anthocyanins**	+	-	-	-	-	-
10	**Phenols**	+	-	-	-	-	-
11	**Coumarins**	+++	+	++	++	+	-
12	**Leucoanthocyanins**	++	-	-	-	-	-
13	**Quinones**	+	-	-	-	-	-

(+++) more amount, (++) moderate amount, (+) less amount, (-) absent

Table.4 Fluorescence analysis of *T. portulacastrum*

Sr No.	Treatement	Visible light	Under UV light short wave length (254 nm)	Under UV light long wave length (365 nm)
1	**1 N NaOH(aq)**	Green	Black	Black
2	**1 N NaOH(alco)**	Green	Black	Dark green
3	**Ammonia**	Dark green	Black	Dark green
4	**Petroleum ether**	Yellow	Green	Dark green
5	**50% HCl**	Dark green	Black	Dark green
6	**50% H_2SO_4**	Dark green	Black	Brown
7	**Ethyl acetate**	Dark green	Black	Light yellow
8	**Ethyl alcohol**	Dark green	Black	Brown
9	**Methanol**	Dark green	Black	Brown
10	**50% KOH**	Brown	Black	Dark green
11	**50% HNO_3**	Brown	Black	Black
12	**Acetic acid**	Dark green	Black	Brown
13	**Iodine in water (1%)**	Yellowish green	Black	Creamish brown
14	**FeCl3**	Blackish green	Black	Light black

The total ash in whole plant powder was 11.83%, while water soluble ash and acid insoluble ash was 1.5 and 0.83% respectively. The sulphated ash of whole plant powder was 17.1 %.

The nitrated ash of whole plant powder was 16.83%. The carbonated ash of whole plant powder was 17.83%. The extractive value of whole plant powder is given in Figure 6. The maximum soluble extractive value was found in methanol (8.64%). Minimum soluble extractive value was found in petroleum ether (0.52 %). The water soluble extractive value was 17.74%.

Phytochemical analysis

The qualitative phytochemical screening of the crude powder of *T. portulacastrum* plant is given in Table 4. In the crude powder of whole plant, coumarins were present in maximum amount followed by saponins and leucoanthocyanins (Table 4). Alkaloids, flavonoids, tannins, steroids cardiac glycosides, triterpenes, anthocyanins, phenols, quinones were present in trace amount while phlobatanins were absent.

The qualitative phytochemical analysis of the plant *T. portulacastrum* in different solvent extracts is given in Table 4. In PE solvent extract, steroids were present in moderate amount; alkaloids, saponins and coumarins were present in trace amount while remaining phytoconstituents were absent (Table 4). In TO solvent extract, steroids were present in maximum amount followed by coumarins; alkaloids and flavonoids were present in trace amount while remaining phytoconstituents were absent. In EA solvent extract, steroids were present in maximum amount followed by coumarins; flavonoids and triterpenes were present in trace amount while remaining phytoconstituents were absent. In ME solvent extract, alkaloids, tannins, steroids and triterpenes were present in moderate amount; flavonids and coumarins were present in trace amount while remaining phytoconstituents were absent. In AQ solvent extract, alkaloids

and saponins were present in moderate amount; flavonoids were present in trace amount while remaining phytoconstituents were absent.

Pharmacognostical, physicochemical and phytochemical studies are important because once the plant is dried and powdered, it loses its morphological identity and is easily prone to adulteration. Pharmacognostic studies ensures plant identity, lays down standardization parameters which prevent the drug from adulterations. Such study helps in authentication of the plants and ensures reproducible quality of herbal products, which lead to safety and efficacy of natural products (Chanda, 2014; Singh *et al.,* 2017) Standardization is a system to ensure that every packet of medicine that is sold has the correct amount and will induce its therapeutic effect. For the useful application of the plant parts in modern medicine, physico-chemical and phytochemical standardization is also very important (Saxena *et al.,* 2012).

Organoleptic and macroscopic evaluation is a qualitative evaluation based on the study of morphological profile of the plant. The macroscopic evaluation of *T. portulacastrum* showed that the plant was green in colour, shape of leaves was obovae, apex was apicular and base was asymmetrical. The stem was light pink in colour and woody. The microscopic evaluation showed leaf lamina was dorsiventral, unicellular or multicellular trichomes were present. Vascular bundles were conjoint, collateral, close type. Stem showed single layered epidermis, cortex region, secondary growth of vascular bundles, with conjoint, collateral, close, arranged in ring form. The powder study showed unicellular trichomes, spiral vessels, annual vessels, bordered pitted vessels, pitted vessels, paracytic stomata, sclerenchymatous cells, etc. Such studies are reported for other plants like *Eucalyptus globules* leaf (Shah *et al.,* 2012) and *Madhuca indica* leaf (Moteriya *et al.,* 2015).

The physicochemical parameters like loss on drying, total ash, acid insoluble ash, water soluble ash, carbonate, nitrated and sulphated ash were determined. The values were in accordance to those reported earlier (Joshi, 2011). Loss on drying was 9.5%. This indicates that drying process was efficient. Loss on drying for *Chaetomorpha antennina* was 7% (Dhanki *et al.,* 2018), for *Cinnamomum verum* leaf, it was 8.2% (Kumar *et al.,* 2012) and 8.8% for *Garcinia indica* fruit rind (Prasad *et al.,* 2012). This is an important parameter since it indicates the stability of the drug during storage time (Mukherjee, 2002). If the drying process is not efficient, i.e. high moisture content will encourage the growth of microorganism which may lead to the degradation of phytoconstituents of the drug during storage (Evans, 2005). The ash values ranged from 0.83% to 11.83%. Total ash value was 11.83% while acid insoluble ash was 0.83%. These values indicate the amount of organic and inorganic material present in the plant sample. The acid insoluble ash normally contains silica and earthy material and indicates contamination. In the present work, it was very negligible hence it can be stated that the plant material is free from contamination. The total ash values are in accordance with those reported for other plants. For e.g. the total ash value was 14% for root of *Cryptolepis sanguinolenta* (Odoh and Akwuaka, 2012); 11% for stem bark of *Ficus benghalensis* (Semwal *et al.,* 2013) and 17% for *Cassytha filiformis* aerial parts (Ambi *et al.,* 2017).

Extractive values give an idea about the chemical constituents of crude drugs and also help in estimation of definite constituents soluble in a particular solvent. The extractive values of organic solvents of *T.*

portulacastrum ranged from 0.52% to 8.64% and water soluble extractive value was 17.74%. This suggests the present of more polar compounds than non-polar compounds. Similar results are reported for other plants. Water soluble extractive value was 20.8% for *Celosia argentia* aerial parts (Ghorpade *et al.*, 2012); 18.23% for *Manilkara zapota* (Nagani *et al.,* 2012). The extractive value was minimum in petroleum ether (0.52); as also reported for *Cordia dichotoma* leaf (0.6%) (Rahman and Hussain, 2015); *Terminalia bellerica* leaf (0.9%) (Menpara *et al.,* 2014) and *Ventilago calyculata* bark (2%) (Kumar *et al.*, 2015).

The qualitative phytochemical analysis was done in crude powder and various solvent extracts of the plant. The crude powder of *T. portulacastrum* was rich in coumarins; while its solvent extracts TO and EA were rich in steroids. The plants are endowed with various secondary metabolites that exert particular physiological effect. The preliminary screening will give an idea about the chemical nature of the drug and hence an idea about its therapeutic efficacy. Phytochemical analysis for various solvent extracts of *Strychnos potatorum* leaves is reported by Kagithoju *et al.,* (2013) and *Thespesia populnea* root by Patil *et al.,* (2012). The information obtained through such studies will be helpful in further studies of the plant under investigation.

The fluorescence analysis is a simple, rapid pharmacognostic procedure, which is useful in the identification of authenticity of crude drugs and recognizes adulterants. In the fluorescence analysis, the plant parts or crude drugs are examined as such or in their powdered form with a number of various polar and non-polar reagents. It is a valuable analytical tool in the identification of plant samples and crude drugs (Denston, 1946). The fluorescence analysis of *T. portulacastrum* displayed an array of colours that could be employed for identification of probable classes of compounds in the plant. Fluorescence is the phenomenon exhibited by various chemical constituents present in the plant material in the visible range in day light. The ultraviolet light produces fluorescence in many natural products (e.g. alkaloids like berberine) which do not visibly fluoresce in daylight. Some of the substances may be often converted into fluorescent derivatives by using different chemical reagents though they are not fluorescent, hence we can often assess qualitatively some crude drugs using fluorescence as it is the most important parameter of pharmacognostical evaluation (Ansari, 2006; Gupta *et al.,* 2006). Fluorescence analysis is reported for other plants like *Bombax ceiba* (Wahab *et al.,* 2012), *Terminalia arjuna*, (Desai and Chanda, 2014) and *Cyathula prostrate* (Sonibare and Olatubosun, 2015).

Pharmacognostic studies are not part specific. All parts of the plant are important and show therapeutic efficacy, though their efficacy varies. Hence pharmacognostic studies should be done for the part of the plant which is under investigation. Some of the examples of pharmacognostic studies of different parts reported in the literature are root (Shah *et al.,* 2011); rhizome (Jha *et al.,* 2012); stem (Nagani *et al.,* 2011); leaf stem and root of *Ageratum conyzoides* and *Asparagus officinalis* (Janarthanan *et al.,* 2016; Begum *et al.,* 2017); leaf (Rakholiya and Chanda, 2012); Aerial parts of *Achyranthes aspera* (Shukla *et al.,* 2018); flower (Baravalia *et al.,* 2012), Pseudobulbs of *Coelogyne cristata* (Pramanick, 2016); seed (Pande *et al.,* 2018).

The organoleptic, macroscopic, microscopic characters, phytochemical, physicochemical, fluorescence studies results of this study could be used for the quality control of the crude drug. They will also help to maintain the efficacy and identity of the drug and will

prevent mishandling of the drug. These parameters can be used as reference standards of this plant and also help in preparation of a monograph.

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