JKAU: Mar. Sci., **Vol. 32** No. 1 pp: 1-19 (2022 A.D.)
DOI :10.4197/Mar.32-1.1

Pharmacognosy Determination and *in vitro* Antioxidant, Anti-Inflammatory, Antimycobacterial Activity of Salt Marsh Plants: *Sesuvium portulacastrum* and *Salicornia brachiata*

Anuradha Venkatraman[1], Syed Ali Mohamed Yacoob[2*], Yogananth Nagarajan[2], Malathi Jojula[3] and **Suganya Vasudevan[4]**

*[1]PG & Research Department of Biochemistry, Mohamed Sathak College of Arts & Science, Chennai.India, [*2]PG & Research Department of Biotechnology, Mohamed Sathak college of Arts & Science, Chennai. India, [3]Department of Microbiology, Sri Shivani College of Pharmacy, Warangal, India, and [4]Department of Biochemistry, Shrimati Indira Gandhi College, Trichy, Tamil nadu, India*

* syedmicro555@gmail.com

Abstract. Mangroves are trees or large shrubs which have special adaptations to survive in this environment and grow within the intertidal zone in tropical and subtropical regions. *Sesuvium portulacastrum* (seapurslane) is, herbaceous, perennial, dichotomous, halophyte fast growing plant that belongs to family *Aizoaceae*. *Salicornia brachiata* Roxb, is a halophyte, commonly known as sea asparagus widely used as food item in several countries. Then, *In vitro* studies like, antioxidant, anti-inflammatory and antimycobacterial assay was carried out. The IC_{50} values of *Salicornia brachiata* and *Sesuvium portulacastru* was found to be 288.166, 369.451 and 369.764 µg/ml for DPPH scavenging activity. The presence of various primary and secondary metabolites was revealed in the present study. It also showed the better *in vitro* activities and was the most active plants against MDRTB, MTB and H37RV strain. This study validates the medicinal use of plants in the treatment of TB which have promising effect against MDRTB, MTB and H37RV.

Keywords: *Sesuvium portulacastrum*, *Salicornia brachiata*, Antimycobacterial activity, MDRTB, MTB, H37RV.

1. Introduction

A *mangrove* is a bush or little tree that rises in coastal saline or salty water. The term is similarly used for tropical seaside plants comprising of such species. *Mangrove* are salt-tolerant trees, as well as called halophytes, and are adjusted to file in harsh coastal conditions, they enclose a complex salt filtration method and complex root system to survive with salt water immersion and wave action. *Mangroves* are different brands of trees up to medium height and bushes that grow saline coastline sediment habitats in the tropics and subtropics (Giri *et al.*, 2012).

Mangroves, the halophytic (salt tolerant) plants thrive in saline conditions and daily inundation form a unique and dominant ecosystem comprised of intertidal marine plants. They afford vital structure as habitat and food for similarly adapted resident and transient fauna (Duke and Schmitt, 2015).

Sesuvium portulacastrum plant it is used as an ornamental plant which is distributed throughout the world. Based on the 'chemical classes' and structures metabolites' from mangrove plants were identified and classified (Lonard and Judd 1997). *Sesuvium portulacastrum* is a straggling perennial herb that breeds in coastal areas throughout the

world. The extract of *Sesuvium portulacastrum* was obtained by extraction method using aqueous, ethanolic and dichloride methane as solvents.

Sesuvium portulacastrum is a perennial herb up to 30 centimeters high, with thick, smooth stems up to 1 meter long. It has smooth, fleshy, silky green leaves that are linear or lance late, from 10-70 millimeters long and 2-15 millimeters wide. Flowers are pink or purple (Lokhande *et al.,* 2011).

These plant compounds are used for the treatment of epilepsy, conjunctivitis, dermatitis, haematuria, leprosy and purgative, toothache and also as antimicrobial agent. Extract of this plant and the essential oil from the fresh leaves of *S. portulacastrum* showed good antibacterial, antifungal as well as antioxidant activity. The ethanolic extract of *S. portulacastrum* showed excellent activity against gastrointestinal disorders like indigestion, dysentery, and diarrhea (Chanrasekaran *et al.,* 2011).

Likewise the ethanolic extract of the medicinal plant *S. portulacastrum* showed potential function against the causative agents of nosocomial infections, *Staphylococcus aureus* and *E. coli.* The antibacterial activities of penicillin G, cefotaxime and vancomycin were compared with ethanol extract and exhibited a broad range of activity against gram positive and gram negative bacteria (Michael *et al.,* 2006). Methanol extract of *Sesuvium portulacastrum* at the doses of 150 mg/kg altered the glutathione peroxidase, glutathione reductase, superoxide dismutase, and catalase. Glutathione levels were decreased towards the normal levels in a dose dependent manner in rats using Silymarin as standard drug (Sheela and Udhayalakshmi, 2014).

Salicornia brachiata, the family *Chenopodiaceae* grow on brackish soil. Common names for the genus include glasswort, pickle weed and marsh samphire which are also used for some species of *Salicornia. Salicornia brachiata* is seen along with the marshy land of Odisha shoreline (Patnaik *et al.,* 2016). *Salicornia brachiata,* considered to be a potential alternative crop for seawater agriculture which is a halophyte plant that grows in salty marshes. *Salicornia* seeds are rich in protein, and its tender shoots are consumed as salad greens. They grow prostrate to erect, their simple or branched stems are succulent, glabrous, and apparently jointed. Older stems may be slightly woody basally. The conflicting leaves are fleshy, glabrous, sessile, basally connate and decurrent and enclosing the stem. The leaf edges are reduced to small collar-like scales with fine margin. Mangroves are an important source of blue carbon.

The *Salicornia brachiata* species are small, succulent herbs with a articulated horizontal main stem and erect lateral branches. Many species are green, but they turn red in autumn. The androgynous flowers are wind pollinated, and the fruit is small and juicy and contains a single seed. The highly salty and salt tolerant, crunchy, succulent, fleshy, twig-like, bushy halophyte plants of the genus. The species grows in the salty environments such as salt-marshes, intertidal zones of Europe and Asia. The plants are succulent with fleshy stem, and small leaf like scales with tiny flowers. The stem grows from jointed nodes. It is an obligate halophyte represented by more than 50 species, all over the world occurring in the intertidal zones and salt marshes which are frequently inundated by sea water. *Salicornia brachiata* and *Salicornia herbacia* are reported from India. *Salicornia brachiata* is dominant and grows under a wide range of salinity. The seed of Salicornia brachiata contains 24-28% oil (Krishnaiah *et al.,* 2011).

2. Materials and Methods

2.1 Collection and Extraction of Mangrove Plants

The fresh leaves, bark and root of *Sesuvium portulacastrum* and *Salicornia*

brachiata were collected from Muthukaadu *Mangrove* forest, Kovalam, dated on 14.01.2020 (Longitude 12.8270° N, Latitude 80.2403° E) Chennai (Plate 1), Tamil Nadu, India and identified by Dr Jayaraman, Institute of Plant Anatomy division, Tambaram, Chennai, India. The samples containing Old, insect damaged and fungus infected leaves were removed carefully. Healthy samples were alone washed and dried under shade condition. Finally, they were crudely powdered and the extraction was carried out with methanol by sox let apparatus. Crude was kept at 4^0C for further use.

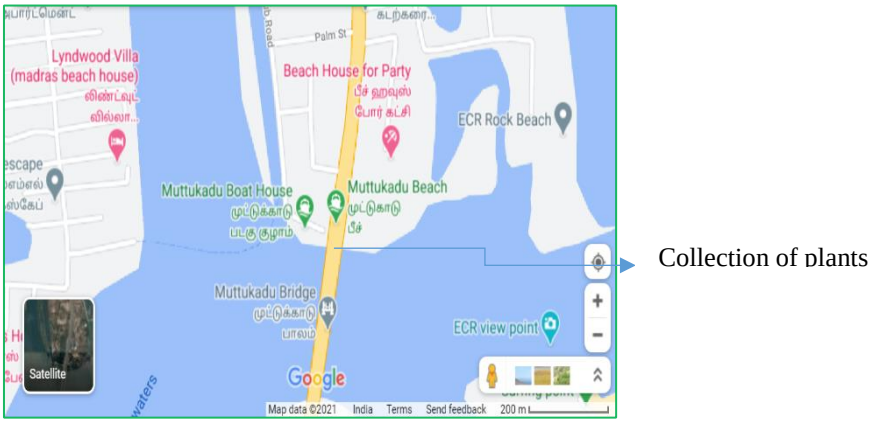

Plate 1. Map of collection site at Muttukadu backwater.

2.2 Qualitative Determination of Primary and Secondary Metabolites

Primary metabolites such as Total soluble Carbohydrates, proteins, Chlorophyll and lipids (Geetha and Geetha, 2014) were determined using standard methods. Likewise, Secondary metabolites like Total Phenols, Tannins and Flavonoids (Siddhuraju and Becker, 2003) were also performed.

2.3 Determination of Proximate Composition

Moisture content, Ash Content, Crude Proteins, Crude firbe, and Fat contents were identified using A.O.A.C, 2005 methods.

2.4 Extractive Values, Organoleptic Features and Fluorescence Analysis

Alcohol Soluble Extractive, Water Soluble Extractive and Ether Soluble extractive values were calculated using the method carried out by (Mukharjee *et al*., 2008). Thereby, organoleptic features such as color, odor, taste, size and shape was analyzed Gautam *et al.*, 2010; Ahmad *et al.*, 2013). Fluorescence analyses of dry powder samples were mixed with various solvents and observed under UV/ visible chamber (Mritunjay Kumar).

2.4 In vitro Total Antioxidant Activity and Free Radical Scavenging Assays and Anti-Inflammatory Activity

The total antioxidant and radical scavenging activity of the methanolic extract of *Sesuvium portulacastrum* and *Salicornia brachiata* was analyzed using standard protocol. *In vitro* assays such as Total Phenolic, Total Flavonoids and Total antioxidant activity along with DPPH assay, Hydrogen peroxide activity, Nitric oxide scavenging assay, Ferric reducing power assay, Deoxyribose non-site specific hydroxyl radical scavenging activity, Superoxide radical, ABTS assay, estimation of lipid peroxidation using egg yolk and β carotene linoleic acid assay was carried out based on

the different protocol (Suganya *et al.,* 2017). The *in vitro* anti-inflammatory activity like protein denaturation and HRBC membrane stabilization method was also done (Suganya *et al.,* 2017).

2.5 Antimycobacterial Activity

a. Sample for testing anti-tuberculosis activity

The evaluation of anti-tuberculosis testing methods was carried out using *Sesuvium portulacastrum* and *Salicornia brachiata extracts.*

b. Source of Mycobacterial Strains and Preparation of Inoculums

The clinical sputum were collected from District Tuberculosis Center, MGM hospital, Warangal. To the LJ solid medium test samples was inoculated and incubated for 8 weeks at Department of Microbiology, Sri Shivani College of Pharmacy. Based on morphological and biochemical methods the cultures were identified as *M. tuberculosis*. Further, the clinical isolates were preserved at -20ºC in liquid broth containing 10% glycerol; retrieve of the culture was carried by sub culturing on sterile L-J medium and incubated for a period of 8 weeks. At 4th week, culture was used to prepare the Mycobacterial suspension in middle brook media, according to McFarland turbidity method. The bacterial suspension was regimented by vortex mixture and the turbidity was adjusted in agreement with tube according to McFarland no.1 scale (3.2×106 cfu/ mL). The inoculum was prepared by diluting the bacterial suspension in the proportion of 1:20 in Middle Brook 7H9 broth medium. This diluted suspension (100 µL) is used to inoculate for screening the drug activity (Murahari D *et al.,* 2018). *M. tuberculosis* H37RV was taken as a control strain for testing of antimycobacterial activity compounds.

c. LJ Media Preparation

Fresh egg and glycerol was used as Lowenstein-Jensen medium for the isolation and differentiation of *M. tuberculosis*. Glycerol present in LJ medium favors the growth of *M. tuberculosis*.

d. Middle Brook Media (Liquid media)

Middle brook 7H9 Broth purchased from Himedia labours pvt, Ltds Mumbai. Middle brook 7H9 Broth (Ammonium sulphate 0.05%, Disodium phosphate 0.25%, Monopotassium phosphate 0.1%, Sodium citrate 0.01%, Magnesium sulphate 0.005%, Calcium chloride 0.00005%, Zinc sulphate 0.0001%, Copper sulphate 0.0001%, Ferric ammonium citrate 0.004%, L-Glutamic acid 0.05%, Pyridoxine 0.0001%, Biotin 0.00005%) is a liquid growth medium prepared for culturing *Mycobacterium tuberculosis*.

e. Glycerol and OADC

Glycerol (2ml) added to the media, dissolves the ingredients by heating and autoclave at 121ºc for 15 minutes to sterilise this solution keep indefinitely cool it. Bovine Albumin Fraction v (2.50gm), Dextrose (1.00), Catalyse (0.002gm), Oleic acid (0.025gm), sodium chloride (0.425gm), distilled water (50ml). The OADC were added to the cool medium under aseptic condition. Within 5–7 days after inoculation and once a week thereafter for up to 21 days the cultures were read spectrophotometrically at 450 nm.

f. Preparation of Stock Solution for Screening Antimycobacterial Activity

The compounds were dissolved in suitable water solvents and stock solution of concentration 1mg/ml was prepared. The test compounds were diluted to various concentrations ranging from 4 µg/ml - 1000µg/ml.

g. Culture Inoculation of Test Samples and Mycobacterium

Specific concentrations of test compounds were added individually to the freshly prepared sterile media and mixed well. A loop of diluted Mycobacterial subculture and control were inoculated into sterile medium separately in respective tubes under

aseptic conditions and mixed properly using Vortex. The culture was incubated at 37 °C over the period of growth. The samples were determination visually after 3rd, 5th, 7th, 9th, 15th, 21st days of static incubation at 37 °C. The MICs (Minimum Inhibitory Concentration) were defined as the lowest concentration of the compound at which no visible bacterial growth was observed.

h. Confirmation of Antimycobacterial Activity

Anti-mycobacterial activity of *Sesuvium portulacastrum* and *Salicornia brachiata* extracts was assessed by the presence of turbidity on 7^{th}, 9^{th}, 15^{th} and 21^{st} day and was confirmed by smear method and biochemical test [catalase test] after 21 days of incubation.

3. Results

In the present study qualification of primary metabolite in whole plant of *Salicornia brachiata* and leaf, stem part of *Sesuvium portulacastrum* has been under taken. The result was present in the Table 1. The total carbohydrates of 32.18 ± 0.24 mg/g dw, chlorophyll of 4.24 ± 0.75 mg/g dw, protein of 1.91 ± 0.10 mg/g dw and lipids of 0.14 ± 0.31 mg/g dw are extracted from the whole plant of *Salicornia brachiata*. The leaf part of *Sesuvium portulacastrum* shows 50.36 ± 0.53 mg/g dw of carbohydrates, 7.89 ± 0.33 mg/g dw of chlorophyll, 3.18 ± 0.11 mg/g dw of protein and 0.38 ± 0.30 mg/ g dw of lipids whereas the stem part of *Sesuvium portulacastrum* shows lower quantity of Carbohydrates (24.18 ± 0.21 mg/g dw), chlorophyll (5.24 ± 0.45 mg/g dw), protein (2.91 ± 0.02 mg/g dw) and lipids (0.54 ± 0.46 mg/g dw) when compared to the leaf part.

In the present study quantification of secondary metabolite in whole plant of *Salicornia brachiata* and leaf, stem of *Sesuvium portulacastrum* has been Determined and the results are present in the Table 2. The total phenolic content of 12.45 ± 0.12mg/g dw, tanninof 5.24 ± 0.54mg/g dw, and flavonoids of 7.23 ± 0.70mg/g dw are gained for the whole plant of *Salicornia brachiata* similarly, the leaf and stem part of *Sesuvium portulacastrum* produces 8.67 ± 0.21 and 5.18 ± 0.13 mg/g dw of Total Phenolic, 4.78 ± 0.45 and 3.05 ± 0.79 mg/g dw of Tannin and 6.29 ± 0.17 and 4.46 ± 0.10 mg/g dw of Total flavonoids respectively.

From Table 3 it is founded that Moisture content (12.05 ± 0.12 %), Ash content (2.52 ± 0.75 %), Crude protein (7.15 ± 0.42 %), Crude fiber (2.46 ± 0.26 %) and Fat content (1.62 ± 0.34 %) of stem part of *Sesuvium portulacastrum* was higher than in the leaf part of *Sesuvium portulacastrum* and whole plant of *Salicornia brachiata.*

The range of alcohol extractive % the whole plant of *Salicornia brachiata* were comparatively more (31.02 ±0.31%) followed by water soluble extractive % of (1.32 ± 0.72%) and ether soluble extractive % was (1.14 ± 0.46%) as shown in Table 4. *Sesuvium portulacastrum* shows higher alcohol soluble, water soluble and ether soluble extractive in leaf part (25.36 ± 0.85 %, 2.75 ± 0.03 % and 5.45 ± 0.98 %) than stem part (18. 25 ± 0.12 %, 1.72 ± 0.32 % and 2.14 ± 0.41 %) respectively.

The organoleptic features of *Salicornia brachiata* whole plant was green in color, produces algae odour with sour taste and the size ranges from 7.5-8.2 cm long with Vegetative structure. Similarly, the leaf and stem of *Sesuvium portulacastrum* produces light red and light brown. The leaf shows odorless and stem shows turmeric odor and the taste of these samples was bitter. The size of leaf of *Sesuvium portulacastrum* ranges from 2.5-3.8 cm long and stem ranges from 4.6-6.3 cm long with star shape (Leaf) and rod shape (Stem) Table 5.

Under fluorescence analysis the whole plant powder of *Salicornia brachiata* and leaf, stem part of powdered *Sesuvium portulacastrum* gives different colors based on the various solvents used. The color gained was mentioned in Table 6.

The total phenolics, flavonoid and antioxidant content were measured spectrophotometry and it was conducted based on standard method. Gallic acid was used as standard drug. Total phenolic content (2.40 mg equivalent standard drug/ g dw), flavonoid content (1.73 mg equivalent standard drug/ g dw) and Total antioxidant (3.49 mg equivalent standard drug/ g dw) varied widely among analysed extract of the whole plant of *Salicornia brachiata.* Among two different extract (Leaf and Stem) of *Sesuvium portulacastrum* it was founded that Total Phenolic (1.32 mg equivalent standard drug/ g dw), Total Flavonoid (1.59 mg equivalent standard drug/ g dw) and Total Antioxidant activity (2.34 mg equivalent standard drug/ g dw) of leaf extract was higher when compared to stem extract which possess 1.08 mg equivalent standard drug/ g dw of Total Phenolic, 0.92 mg equivalent standard drug/ g dw of Total Flavonoid content and 2.09 mg equivalent standard drug/ g dw of Total antioxidant content as shown in Table 7.

The evaluations of anti-radical properties of the whole plant of *Salicornia brachiata* and leaf stem extract of *Sesuvium portulacastrum* was performed by DPPH radical scavenging assay. In the present study, the percentage of scavenging effect on the DPPH radical was concurrently increased with the increase in the concentration of both *Salicornia brachiata* and *Sesuvium portulacastrum* (leaf and stem) extracts from 100 -500 µg/ml. The percentage of inhibition was exist from 16.88 % at 100 µg/ml to 68.68 % at 500 µg/ml for leaf extract of *Sesuvium portulacastrum* and for stem extract of *Sesuvium portulacastrum* they were 15.16% at 100µg/ml and 65.52 % at 500 µg/ml (Table 8). Similarly, the whole plant of *Salicornia brachiata* ranges from 17.78 % to 84.84 % for concentration 100-500 µg/ml. All the test samples showed maximum inhibition than the standard drug which produces 64.71 % for concentration 500 µg/ml.

The hydrogen peroxide scavenging activity of *Salicornia brachiata*, *Sesuvium portulacastrum* leaf and stem extracts increased constantly with the increase in the volume of extract from 100 - 500 µg/ml. When compared with the stem extract (96.55 % at 500µg/ml), leaf extract (92.96 % at 500 µg/ml) and whole plant (90.03 % at 500 µg/ml) showed lower activity. It is founded that the activity of test samples was higher than the standard drug (84.26 %) tabulated in Table 9.

This study reports that the extract of *Salicornia brachiata* (90.19 %) and stem extract of *Sesuvium portulacastrum* has highest antioxidant activity (84.85 %) than that of its leaf extract of *Sesuvium portulacastrum* (75.16 %) when compared with the standard drug (82.45 %) which is represented in Table 10.

Ferric reducing activity was tested for three different samples. From Table 11, it is observed that as the concentration of the samples increases from 100-500 µg/ml, the OD also increases based on their reducing capacity.

The extracts of *Salicornia brachiata* and *Sesuvium portulacastrum* were effective scavengers of the deoxyribose radical. The activity of the *Salicornia brachiata* whole plant extracts, *Sesuvium portulacastrum* (leaf, stem) was comparable to that of standard drug. At 500 µg/ml, the inhibition values (%) are 78.66 %, 88.78 %, 73.60 % and 85.36 % for standard drug, whole plant, and leaf and stem extract respectively. On the other hand, at 100µg/ml the inhibition values (%) are 29.96 %, 42.27 %, 16.55 % and 34.61% for standard drug, whole plant, leaf and stem extract respectively. The IC_{50} values for all the samples are presented in Table 12.

From the result, it was observed that the *Salicornia brachiata* and leaf extract of *Sesuvium portulacastrum* had higher activity than the stem extract of *Sesuvium portulacastrum*. At a concentration 500 µg/ml, the scavenging activity of *Salicornia brachiata* and leaf extract of *Sesuvium portulacastrum* reached 81.28 % and 80.30 %, while the

standard drug and stem extract used were 78.75 % and 77.35 % respectively. The IC_{50} value for test samples and standard drug are presented in Table 13.

The superoxide scavenging activity of *Salicornia brachiata* whole plant and *Sesuvium portulacastrum* leaf, stem extracts were determined and the results were subjected to the superoxide activity and the results were shown in Table 14. It shows that extract of *Salicornia brachiata* whole plant (500µg/mL) exhibited the maximum superoxide scavenging activity of 95.74% which is higher than the standard drug, leaf, stem extract of *Sesuvium portulacastrum* whose scavenging effect is 88.70 %, 84.24 % & 93.60 % respectively.

The SOD activity of the extracts stated that the percentage of inhibition increased consistently with the concentration of the extracts (Table 15). About 85.47%, 82.41 and 82.16 % of the activity was observed for ***Salicornia brachiata,*** **standard drug,** stem of ***Sesuvium portulacastrum*** the extracts for concentration 500 µg/ml. At specific concentration, the SOD activity of the leaf ***Sesuvium portulacastrum*** extracts (77.95 %) was lesser than the standard and other two test samples.

In present study, the lipid peroxidation activity of three different extract alone with standard were revealed and the results (OD values and percentage) are represented in Table 16. All these samples exhibit the ability to scavenging lipid peroxidase at various degrees. The *Salicornia brachiata* extract showed the maximum activity (88.92 %) with the IC 50 values 267.765 µg/ml when compared to other two test sample *Sesuvium portulacastrum* leaf (79.71 %), stem (85.21 %). The scavenging effect of standard drug was founded to be 78.01 % with IC 50 values 313.030 µg/ml.

Percentage of inhibition for standard BHT showed 18.48 % at 100 µg/ml and 87.74 % at 500 µg/ml concentration which is compared with the three extract that possess14.85%, 21.76 % & 13.47 % at 100 µg/ml and 85.49%, 93.61 % & 80.48 % at 500 µg/ml concentration respectively. Therefore, the IC_{50} values were depicted in Table 17.

Proteinase inhibitory activity of three different samples such as *Salicornia brachiata*, leaf, stem of *Sesuvium portulacastrum* was estimated. Among all the three extract, *Salicornia brachiata* (85.52%) has the highest inhibitory activity followed by the leaf extract of *Sesuvium portulacastrum* and the least inhibitory was founded in stem extract of *Sesuvium portulacastrum* at concentration 500 (µg/ml) **(**Table 18**).**

In the present study, various concentrations (100-500µg/ml) of three different extract were used for HRBC stabilization analysis. The results obtained were depicted in Table 13. It showed maximum inhibition of 71.04 % at concentration 500 µg/ml by stem extract of *Sesuvium portulacastrum*. The leaf extract of *Sesuvium portulacastrum* (63.88 %) and whole plant extract of *Salicornia brachiata* (61.49 %) showed only minimum inhibition for concentration 500 µg/ml when compared to stem extract of *Sesuvium portulacastrum* (Table 19).

The antimycobacterial activity of *Salicornia brachiata* and both stem and leaf of *Sesuvium portulacastrum* was screened in liquid media and it MICs were determined against MTB, MDRTB and H37RV strains at different concentration (500µg/ml, 250 µg/ml, 125 µg/ml, 64 µg/ml and 32 µg/ml). Confirmatory test such as Smear test shows that *Salicornia brachiata* produce Positive (+ve) for MTB, MDR-TB and Negative (-ve) for H37RV at concentration 500µg/ml and Biochemical Test such as Catalase test also showed positive at 500µg/ml concentration which was indicated by bubbles in samples and by means growth of culture respectively. On a contrary, no turbidity was found in the tubes treated with *Salicornia brachiata* shown negative for MDRTB& MTB and positive for

H37RVat 500µg/ml concentrations, which means that the drug was found to be active towards *Mycobacterium*. Based on the result, it is also founded that *Sesuvium portulacastrum* (Leaf) extract shows positive for all MDRTB, MTB and H37RV strain which mean that Activity was found at 500µg/ml were shown in all strain of MTB, H37RV, MDR-TB. Similarly, *Sesuvium portulacastrum* (Stem) produces negative for MDRTB, MTB and positive for H37RV strain that concluded that the activity was found at 500µg/ml were shown in H37RV but not in MTB, MDR-TB (Table 20, Fig. 1-3).

Table 1. Quantification of primary metabolites.

Primary metabolites	*Salicornia brachiata* Whole plant Weight (mg/g dw)	*Sesuvium portulacastrum*	
		Leaf Weight (mg/g dw)	Stem Weight (mg/g dw)
Carbohydrates	32.18 ± 0.24	50.36 ± 0.53	24.18 ± 0.21
Chlorophyll	4.24 ± 0.75	7.89 ± 0.33	5.24 ± 0.45
Protein	1.91 ± 0.10	3.18 ± 0.11	2.91 ± 0.02
Lipids	0.14 ± 0.31	0.38 ± 0.30	0.54 ± 0.46

Values are given in mean ± SD.

Table 2. Quantification of secondary metabolites.

Secondary metabolites	*Salicornia brachiata* Whole plant Weight (mg/g dw)	*Sesuvium portulacastrum*	
		Leaf Weight (mg/g dw)	Stem Weight (mg/g dw)
Total phenolic	12.45 ± 0.12	8.67 ± 0.21	5.18 ± 0.13
Tannin	5.24 ± 0.54	4.78 ± 0.45	3.05 ± 0.79
Total flavonoids	7.23 ± 0.70	6.29 ± 0.17	4.46 ± 0.10

Values are given in mean ± SD.

Table 3. Proximate composition.

Composition	*Salicornia brachiata* Whole plant % Dry Weight	*Sesuvium portulacastrum*	
		Leaf % Dry Weight	Stem % Dry Weight
Moisture content	6.75 ± 0.02	4.21 ± 0.03	12.05 ± 0.12
Ash content	1.15 ± 0.42	1.21 ± 0.17	2.52 ± 0.75
Crude protein	2.47 ± 0.31	3.12 ± 0.56	7.15 ±0.42
Crude fiber	1.05 ± 0.13	0.89 ± 0.03	2.46 ± 0.26
Fat content	0.98 ± 0.86	0.27 ± 0.37	1.62 ± 0.34

Values are given in mean ± SD.

Table 4. Extractive values.

Parameters	*Salicornia brachiata* Whole plant	*Sesuvium portulacastrum*	
		Leaf	Stem
Alcohol soluble extractive %	31.02 ± 0.31	25.36 ± 0.85	18.25 ± 0.12
Water soluble extractive %	1.32 ± 0.72	2.75 ± 0.03	1.72 ± 0.32
Ether soluble extractive %	1.14 ± 0.46	5.45 ± 0.98	2.14 ± 0.41

Values are given in mean ± SD.

Table 5. Organoleptic features.

Organoleptic features	*Salicornia brachiata* Whole plant	*Sesuvium portulacastrum*	
		Leaf	Stem
Color	Green	Light red	Light Brown
Odor	Algae	Odorless	Turmeric odor
Taste	Sour	Bitter	Bitter
Size	7.5-8.2 cm long	2.5-3.8 cm long	4.6-6.3 cm long
Shape	Vegetative structure	Star shape	Rod

Table 6. Fluorescence analysis.

Reagents	*Salicornia brachiata*		*Sesuvium portulacastrum*			
	Whole part Visible	Whole part UV	Leaf Visible	Leaf UV	Stem Visible	Stem UV
Powder	Green	Light brown	Green	Greenish yellow	Light brown	Black
Powder + pet ether	Brown	Red	Light brown	Brown	Light red	Red
Powder + ethyl acetate	Light red	Light brown	Pink	Light red	Light brown	Red
Powder + ethyl acetate: HCl (1:1)	Light red	Red	Brown	Light red	Light brown	Light pink
Powder + methanol	Red	Orange	Light red	Orange	Light pink	Pink
Powder + chloroform	Pink	Dark brown	Orange	Light red	Orange	Red
Powder + acetone	Violet	Red	Light Blue	Violet	Blue	Violet
Powder + 50 % H_2SO_4	Black	Red	Black	Brown	Grey	Black
Powder + 50 % HNO_3	Yellowish red	Orange	Orange	Reddish orange	Light red	Pink
Powder + 50 % HCl	Reddish orange	Black	Red	Light pink	Yellow	Orange
Powder + 10 % NaOH	Pink	Brown	Brown	Light red	Red	Black

Table 7. Total phenolic, Total Flavonoid and Total antioxidant activity of *Salicornia brachiata* Whole plant and leaf; stem of *Sesuvium portulacastrum*.

Test name	*Salicornia brachiata* Whole plant mg equivalent Standard drug/ g dw	*Sesuvium portulacastrum*	
		Leaf mg equivalent Standard drug/ g dw	Stem mg equivalent Standard drug/ g dw
Total Phenolic Content	2.40 ± 0.14	1.32 ± 0.15	1.08 ± 0.03
Total Flavonoid content	1.73 ± 0.65	1.59 ± 0.56	0.92 ± 0.12
Total antioxidant activity	3.49 ± 0.24	2.34 ± 0.15	2.09 ± 0.44

Values are given in mean ± SD.

Table 8. DPPH radical scavenging assay.

Conc µg/ml	Std %	*Salicornia brachiata*	*Sesuvium portulacastrum*	
		%	Leaf %	Stem %
100	13.72 ± 0.151	17.78 ± 0.120	16.88 ± 0.256	15.16 ± 0.251
200	25.90 ± 0.125	32.94 ± 0.145	26.99 ± 0.240	26.62 ± 0.152
300	38.17 ±.0.005	53.43 ± 0.865	42.15 ± 0.108	39.35 ± 0.410
400	44.77 ± 0.125	71.21 ± 0.591	50.99 ± 0.203	45.49 ± 0.784
500	64.71 ± 0.068	84.84 ± 0.023	68.68 ± 0.125	65.52 ± 0.021
IC_{50} Value	403.815	288.166	369.451	396.764

Values are given in mean ± SD; OD – Optical density; IC_{50} - half maximal inhibitory concentration.

Table 9. Hydrogen peroxide scavenging activity.

Conc µg/ml	*Std %*	*Salicornia brachiata*	*Sesuvium portulacastrum*	
		%	*Leaf %*	*Stem %*
100	23.68 ± 0.26	27.22 ± 0.86	33.51 ± 0.56	35.07 ± 0.65
200	40.50 ± 0.52	47.73 ± 0.02	51.42 ± 0.42	54.06 ± 0.23
300	54.91 ± 0.08	63.28 ± 0.25	60.73 ±0.25	66.16 ± 0.82
400	71.08 ± 0.23	74.39 ± 0.66	73.02 ± 0.03	78.69 ± 0.56
500	84.26 ± 0.71	90.03 ± 0.23	92.96 ± 0.16	96.55 ± 0.29
IC_{50} Value	267.800	230.851	212.256	190.873

Values are given in mean ± SD; OD – Optical density IC_{50}- half maximal inhibitory concentration.

Table 10. Nitric oxide scavenging activity.

Conc µg/ml	Std %	*Salicornia brachiata*	*Sesuvium portulacastrum*	
		%	Leaf %	Stem %
100	23.00 ± 0.52	34.36 ± 0.56	19.58 ± 0.86	28.66 ± 0.56
200	36.52 ± 0.26	45.40 ± 0.23	30.17 ± 0.18	40.02 ± 0.32
300	54.76 ± 0.16	61.48 ± 0.12	41.86 ± 0.26	59.00 ± 0.47
400	69.10 ± 0.08	78.99 ± 0.55	60.42 ± 0.46	75.00 ± 0.65
500	82.45 ± 0.46	90.19 ± 0.08	75.16 ± 0.95	84.85 ± 0.16
IC_{50} Value	279.100	216.806	332.261	249.064

Values are given in mean ± SD; OD – Optical density; IC_{50} - half maximal inhibitory concentration.

Table 11. Ferric reducing antioxidant Power (FRAP).

Concentration µg/ml	Standard OD	*Salicornia brachiata OD*	*Sesuvium portulacastrum* Leaf OD	*Sesuvium portulacastrum* Stem OD
100	0.012 ± 0.51	0.018 ± 0.43	0.024 ± 0.11	0.006 ± 0.06
200	0.026 ± 0.24	0.039 ± 0.72	0.041 ± 0.46	0.018 ± 0.46
300	0.039 ± 0.49	0.054 ± 0.61	0.062 ± 0.86	0.029 ± 0.28
400	0.051 ± 0.09	0.078 ± 0.42	0.083 ± 0.22	0.043 ± 0.42
500	0.062 ± 0.18	0.099 ± 0.09	0.108 ± 0.92	0.062 ± 0.05

Values are given in mean ± SD.

Table 12. Deoxyribose Radical Scavenging Activity.

Conc µg/ml	Std %	*Salicornia brachiata*	*Sesuvium portulacastrum*	
		%	Leaf %	Stem %
100	29.96 ± 0.16	42.27 ± 0.09	16.55 ± 0.64	34.61 ± 0.52
200	40.90 ± 0.05	51.98 ± 0.04	38.03 ± 0.12	48.56 ± 0.16
300	57.59 ± 0.46	66.76 ± 0.15	49.11 ± 0.41	61.56 ± 0.48
400	67.58 ± 0.92	76.06 ± 0.62	61.56 ± 0.91	72.09 ± 0.71
500	78.66 ± 0.73	88.78 ± 0.59	73.60 ± 0.46	85.36 ± 0.52
IC_{50} Value	260.203	170.453	316.203	216.532

Values are given in mean ± SD; OD – Optical density; IC_{50} - half maximal inhibitory concentration.

Table 13. ABTS [2, 2'-azinobis-(3-ethylbenzothiazoline-6-sulfonic acid)] Radical Cation Scavenging Assay.

Conc µg/ml	Std %	*Salicornia brachiata*	*Sesuvium portulacastrum*	
		%	Leaf %	Stem %
100	14.53 ± 0.41	16.44 ± 0.34	21.82 ± 0.36	19.49 ± 0.38
200	33.25 ± 0.75	36.56 ± 0.02	40.23 ± 0.51	38.26 ± 0.40
300	54.03 ± 0.59	56.41 ± 0.15	58.95 ± 0.82	57.39 ± 0.16
400	67.32 ± 0.39	69.29 ± 0.85	71.61 ± 0.79	69.03 ± 0.38
500	78.75 ± 0.89	81.28 ± 0.65	80.30 ± 0.46	77.35 ± 0.49
IC_{50} Value	302.609	287.710	269.112	284.272

Values are given in mean ± SD; OD – Optical density; IC_{50} - half maximal inhibitory concentration.

Table 14. Superoxide radical scavenging activity.

Conc µg/ml	*Std %*	*Salicornia brachiata*	*Sesuvium portulacastrum*	
		%	*Leaf %*	*Stem %*
100	29.14 ± 0.15	38.45 ± 0.16	26.86 ± 0.94	33.40 ± 0.25
200	42.62 ± 0.86	50.15 ± 0.25	39.35 ± 0.60	47.77 ± 0.56
300	66.11 ± 0.04	72.15 ± 0.37	61.65 ± 0.09	69.67 ± 0.52
400	76.31 ± 0.52	88.50 ± 0.06	72.65 ± 0.11	81.76 ± 0.14
500	88.70 ± 0.79	95.74 ± 0.16	84.24 ± 0.51	93.60 ± 0.58
IC_{50} Value	230.790	175.773	253.060	201.289

Values are given in mean ± SD; OD – Optical density; IC_{50} - half maximal inhibitory concentration.

Table 15. Superoxide Dismutase scavenging activity (SOD).

Conc µg/ml	*Std %*	*Salicornia brachiata*	*Sesuvium portulacastrum*	
		%	*Leaf %*	*Stem %*
100	17.01 ± 0.49	20.97 ± 0.77	15.44 ± 0.44	19.74 ± 0.34
200	32.78 ± 0.79	33.86 ± 0.49	29.23 ± 0.28	31.79 ± 0.79
300	49.88 ± 0.54	51.86 ± 0.08	46.41 ± 0.46	48.22 ± 0.82
400	67.13 ± 0.17	69.69 ± 0.16	63.91 ± 0.17	66.97 ± 0.68
500	82.41 ± 0.09	85.47 ± 0.35	77.95 ± 0.08	82.16 ± 0.49
IC_{50} Value	300.957	285.622	327.145	301.400

Values are given in mean ± SD; OD – Optical density; IC_{50}- half maximal inhibitory concentration.

Table 16. Estimation of lipid peroxidation using egg yolks.

Conc µg/ml	*Std %*	*Salicornia brachiata*	*Sesuvium portulacastrum*	
		%	*Leaf %*	*Stem %*
100	17.70 ± 0.56	25.38 ± 0.78	18.92 ± 0.52	20.21 ± 0.56
200	32.34 ± 0.45	40.10 ± 0.49	33.79 ± 0.26	36.62 ± 0.44
300	45.76 ± 0.90	57.88 ± 0.51	46.97 ± 0.85	53.68 ± 0.85
400	66.13 ± 0.02	61.68 ± 0.62	69.12 ± 0.46	75.34 ± 0.56
500	78.01 ± 0.94	88.92 ± 0.81	79.71 ± 0.61	85.21 ± 0.87
IC_{50} Value	313.030	267.765	301.899	275.036

Values are given in mean ± SD; OD – Optical density; IC50 - half maximal inhibitory concentration.

Table 17. β carotene linoleic acid assay.

Conc µg/ml	Std %	*Salicornia brachiata*	*Sesuvium portulacastrum*	
		%	Leaf %	Stem %
100	18.48 ± 0.26	14.85 ± 0.48	21.76 ± 0.56	13.47 ± 0.66
200	40.41 ± 0.15	37.65 ± 0.81	44.56 ± 0.51	35.41 ± 0.06
300	60.10 ± 0.19	58.03 ± 0.92	63.04 ± 0.06	53.89 ± 0.52
400	74.78 ± 0.92	72.19 ± 0.48	79.27 ± 0.34	70.12 ± 0.42
500	87.74 ± 0.46	85.49 ± 0.59	93.61 ± 0.48	80.48 ± 0.23
IC_{50} Value	263.549	279.286	241.438	296.005

Values are given in mean ± SD; OD – Optical density; IC50 - half maximal inhibitory concentration.

Table 18. Proteinase inhibitory action.

Conc µg/ml	Std %	*Salicornia brachiata*	*Sesuvium portulacastrum*	
		%	Leaf %	Stem %
100	16.94 ± 0.26	25.86 ± 0.22	25.53 ± 0.50	15.19 ± 0,.64
200	25.99 ± 0.28	46.86 ± 0.03	46.02 ± 0.12	23.79 ± 0.25
300	48.48 ± 0.03	57.92 ± 0.16	56.63 ± 0.55	45.51 ± 0.16
400	63.67 ± 0.16	72.92 ± 0.45	71.62 ± 0.62	58.37 ± 0.09
500	73.37 ± 0.15	85.52 ± 0.22	84.36 ± 0.47	68.00 ± 0.56
IC 50 Value	657.26	492.475	504.621	711.669

Values are given in mean ± SD; OD – Optical density; IC_{50} - half maximal inhibitory concentration.

Table 19. HRBC membrane stabilization test.

Conc µg/ml	Std %	*Salicornia brachiata*	*Sesuvium portulacastrum*	
		%	Leaf %	Stem %
100	13.69 ± 0.53	15.27 ± 0.38	18.48 ± 0.43	20.49 ± 0.09
200	24.02 ± 0.26	25.08 ± 0.06	28.01 ± 0.84	39.12 ± 0.46
300	30.16 ± 0.48	32.45 ± 0.85	35.06 ± 0.35	50.41 ± 0.18
400	43.14 ± 0.15	44.55 ± 0.49	44.83 ± 0.46	64.16 ± 0.56
500	61.16 ± 0.39	63.49 ± 0.34	63.88 ± 0.29	71.04 ± 0.60
IC 50 Value	872.94	838.668	822.041	615.158

Values are given in mean ± SD; OD – Optical density; IC_{50} - half maximal inhibitory concentration.

Table 20. Confirmation of anti-mycobacterial activity of *Salicornia brachiata* and *Sesuvium portulacastrum* based on smear and biochemical tests.

Compound name	MIC Conc (µg/ml)	Strain						Final report
		MTB		MDRTB		H37RV		
		Smear test	B.C test	Smear test	B.C test	Smear test	B.C test	
Sesuvium portulacastrum (Leaf)	500	+ve	+ve	+ve	+ve	+ve	+ve	Activity was found at 500µg/ml were shown in all strain of MTB, H37RV, MDR-TB.
Sesuvium portulacastrum (Stem)	500	-ve	-ve	-ve	-ve	+ve	+ve	Activity was found at 500µg/ml were shown in H37RV but not in MTB, MDR-TB
Salicornia brachiata	500	+ve	+ve	+ve	+ve	-ve	-ve	Active towards MTB and MDR-TB but not towards H37RV.

Fig. 1. *Salicornia brachiata* activities in liquid media and Biochemical test.

Fig. 2. *Sesuvium portulacastrum stem* activities in liquid media and Biochemical test.

Fig. 3. *Sesuvium portulacastrum* leaf activities in liquid media and Biochemical test.

4. Discussion

In the present study, we have evaluated the pharmacognostic activity such as physico chemical analysis, phytochemical analysis of *Salicornia brachiata* and *Sesuvium portulacastrum* along with their importance.

Mangrove plants act as an important source for the development of novel drugs against various life threatening diseases since they are stress tolerant plants and rich in bioactive compounds. Currently, there is a considerable interest in the field of pharmacy and medicine in the use of medicinal and aromatic plants which have natural antioxidants for their potential use. The quantitative analysis of primary metabolites like chlorophyll, carbohydrate, protein, and lipids were evaluated from the whole plant. The present study evaluates the biochemical compounds in *Salicornia brachiata* and *Sesuvium portulacastrum* (Table 1). From the result it was observed that maximum amount of carbohydrate and chlorophyll was found in *Sesuvium portulacastrum*. Similarity to this, Suriyavathana *et al.,* 2016 found maximum chlorophyll in callus of *Triticum aestivum* and other medicinal plants. Phenols and flavonoids are incredible group of compounds found in many plants and also in edible and non-edible plant parts that are responsible for several biological activities (Kahkonen *et al.,* 1999).

In current study, we have estimated the phenolic and flavonoid content of *Salicornia brachiata* and *Sesuvium portulacastrum* pervaded into different solvents based on the order of increased polarity. Methanol assisted as the best solvent for the abstraction of phenolic compounds and acetone was found to be most active solvent for the abstraction of total flavonoids from *Salicornia brachiata*. The discrepancy in the content of phenolic compounds and flavonoids in solvent extracts is endorsed to the differences in polarity of the extracting solvents. The present tentative statistics is similar to that of (Govindasamy *et al.,* 2000) who deliberate the chemical constituents of various mangroves in India.

The proximate analysis data indicated that *Salicornia brachiata* contained an appreciable amount of carbohydrate and crude fibre. Previous studies have shown that consumption of carbohydrates provides the body with the necessary energy required to drive cellular metabolism while dietary fibre could prevent the incidences of cardiovascular diseases, arteriosclerosis and increase intestinal transit time (Mensah *et al*., 2008). The ash content also specifies that it could be a virtuous source of minerals. The moisture

content of the stem might be due to the succulent nature of the plant stem and could serve as a readily available source of fluid for quenching of thirst when dehydrated, especially in hot farm areas where water is not easily assessable to farmers, while the moisture content of the leaf could serve as a source of water to farm animals. The crude fat and protein contents of extract suggested that they could be an important source for dietary fat and protein feed supplementation. Among the plant parts, the maximum percentage extraction was found in Alcohol soluble extractive (31.02 ± 0.31).

In this study, *Salicornia brachiata* the mangrove, collected from Muthukaadu, South India was found to enclose considerable amount of polyphenolics. The total phenolic content was found to be higher in comparison with the species (94.4 mg/g) found in Sundarbans, India (Banerjee *et al.,* 2008). The high content of polyphenolics like tannins was found in Sundarbans, North India Mangroves (Kathiresan *et al.,* 1990). Previous report publicized that mangroves are rich in polyphenols and tannins (Ravi *et al.,* 1990 and Bravo *et al.,* 1998). Phenolics are widely distributed in the plants which act as the most active radical scavengers. They are present in wide range of plants which is exploited as important components of both human and animal diets (Crozier *et al.,* 1997 and Boyer *et al.,* 2004). There is the strong proof on the protective effects of phenolics on age related chronic diseases (Kroon *et al.,* 2005).

An antioxidant is a molecule that prevents the oxidation of other particles. During chemical reaction of oxidation free radicals are produced that leads to chain reactions which may damage the cells. These chain reactions are terminated by Antioxidants such as thiols or ascorbic acid (Vitamin C).

In the modern life style stress plays a chief part and results in numerous diseases such as cancer, diabetes, heart diseases, inflammatory and hypertension. The growing factors of these diseases results in various public health problems. Several synthetic drugs are introduced against disease which results in hostile side effects. An unconventional elucidation for the diseases is by producing natural antioxidant to the body by the food supplements and natural and traditional medicines. From different medicinal plants a number of natural antioxidants have been isolated (Gupta, 2006). Plant substances continue to serve as viable source of drugs for the world population and several plant based drugs are in clinical use (Sofowara *et al*., 1982).Recently plant products has been traditionally used for the treatment of various diseases due to their properties such as antioxidant and free radical scavenging activity. The active components present in the plants are responsible for their antioxidant activity is used as an herbal traditional medicine in India.

In the current study, we have analysed scavenging activities, anti-inflammatory assay and anti-mycobacterial assay are enlisted along with their importance. Antioxidants are vital materials that play a essential role in suspending, intercepting, and inhibiting oxidative reactions catalysed by free radicals and in consequence it provide protection to humans (Vilioglu *et al.,* 1998). Due to this capability there is an increased usage of antioxidants for the maintenance of reactive oxygen species. Butylatedhydroxyl anisole (BHA), Butylated hydroxyl toluene (BHT), Tertiary butylated hydroxyl quinone (TBHQ), and Gallic acid esters are the synthetic antioxidant that are commercially available. These synthetic antioxidants are identified to have latent side effects and possess some degree of carcinogenicity which is recognised by *in vivo* method (Barlow *et al.,* 1990). Hence the use of this synthetic antioxidant is being constrained now-a-days.

Antioxidant materials from plant resources are safe and dismiss the action of free radicals thereby defensive the organism from several diseases. Consequently a special interest to identify the presence of natural

antioxidants in medicinal plants has greatly increased. Natural compounds such as Flavonoids, Terpenes, and Alkaloids was derived from plants which have received considerable attention in contemporary years because of their pharmacological properties including Antioxidant and Anti-inflammatory activities (Xu *et al.,* 2017).

Free radicals are recognized to play a certain function in an extensive variety of pathological appearances. Antioxidants fight free radicals and protect us from numerous diseases (Kim *et al.,* 2009). They exert their action moreover by scavenging the reactive oxygen species or by protecting the antioxidant resistance mechanisms (Umamaheswari and Chatterjee, 2008). 2,2′-diphenyl-1- picrylhydrazyl radical (DPPH) purple-coloured solution bleaching measures the electron donation ability of natural products (Nunes *et al.,* 2012). The technique is based on scavenging of DPPH by the addition of a radical species or antioxidant that decolourizes the DPPH solution. The degree of colour change is proportional to the concentration and strength of the antioxidants. A great reduction in the absorbance of the reaction mixture specifies significant free radical scavenging activity of the compound under test (Krishnaiah *et al.,* 2011).

In the current research work among all the plant parts extracts exhibited significantly higher percentage of inhibition and certainly correlated with total phenolic content. Results of this study propose that the plant extract containing phytochemical components are capable of donating hydrogen to a free radical to scavenge the potential destruction. Superoxide radical deliberated a major natural source of reactive oxygen species (Alves *et al.,* 2010). Even though superoxide anion is a weak oxidant, it gives rise to generation of powerful and dangerous hydroxyl radicals as well as singlet oxygen, both of which contribute to oxidative stress (Meyer and Isaksen, 1995). The results of our work revealed that, *S.braciata* plant part extracts had operative ability of scavenging for superoxide radical and associated with total flavonoid content thus signifying its antioxidant potential. Recent research works have shown that several flavonoid and related polyphenols considerably contribute the phosphomolybdate scavenging activity of medicinal plants (Sharififar *et al.,* 2009). Hydroxyl radical scavenging capacity of an extract is directly proportional to its antioxidant activity which is represented by the low concentration of red colour (Gulcin *et al.,* 2005). The stilt root extracts of maximum activity when added to the reaction mixture vigorously scavenged the hydroxyl radicals and prohibited the degradation of 2-deoxyribose.

ABTS radical scavenging test includes a process that creäte a blue/green. The ABTS radical cation is produced by the oxidation of ABTS with potassium persulfate, in the presence of hydrogen-donating antioxidants is read spectrophotometrically at 745 nm. All the fractions possessed strong ABTS scavenging activity that is supported by other researchers (Sahreen *et al.,* 2017). In reducing power assay, the yellow colour of the test sample changes to green depending on the reducing power of the test specimen. The presence of the reductants in the solution causes the reduction of the Fe3+/ferricyanide complex to the ferrous form. Hence, Fe2+ can be observed at 700 nm. Prior reports suggested that, the reducing properties have been revealed to employ antioxidant action by providing a hydrogen atom to break the free radical chain (Gordon *et al.,* 1990). Increasing absorbance at 700 nm shows an increase in reducing ability.

The antioxidants present in *S.braciata* instigated their reduction of Fe3+/ ferricyanide complex to the ferrous form, and thus demonstrated the reducing activity. The methanol extract demonstrated the maximum total phenolics content, while the substances acquired with residual aqueous fraction were much slighter that is in contract with other reports (Ao *et al.,* 2008). Phenolic compounds of plants are also very important because their

hydroxyl groups converse scavenging ability. Phenolic compounds of plants fall into several categories (Nunes *et al.*, 2012). Flavonoids are naturally occurring in plants and are thought to have positive effects on human health which shows antibacterial, antiviral, anti-inflammatory, anticancer, and anti-allergic activities (Di Carlo *et al.*, 1999). Flavonoids have been shown to be highly effective scavengers of most oxidizing molecules, including singlet oxygen, and various free radicals (Bravo, 1998) implicated in several diseases. So similarly with the findings in the literature for other extracts of plant products (Sahreen *et al.*, 2011) our results proposed that phenolic acids and flavonoids may be the most important contributors for the antioxidant activity as the IC_{50} values of radical scavenging activity of many soluble extracts of *S.braciata* and the contents of phenolics or flavonoids exhibited significant correlation.

The method of lipid peroxidation has been proposed to proceed via a free radical chain reaction (Halliwell, 1989), which has been associated with cell damage in bio membranes. The damage has been shown to impulsive different diseases like cancer, cardiovascular diseases and diabetes. Incubation of brain, liver and egg yolk homogenates in the presence of FeSO4 causes a significant proliferation in lipid peroxidation.

The abilities of the extracts of *S.braciata* are to prevent the process of lipid peroxidation were tested (Ruberto *et al*., 2000). The elevation in the percentage inhibition of lipid peroxidation was observed (IC_{50}= 267.765). The percentage of inhibition of lipid peroxidation induced by leaf extract was the highest in egg homogenate. The growth inhibitory potential of *S.braciata* is against anti-mycobacterial strains was performed and the result has been interpreted. Since, *S.braciata* is to have many roles in pharmacological studies, this work was carried out to discover the *in vitro* antimycobacterial potential of *S.braciata* based on medicinal uses.

In many studies the anti-mycobacterial activity was confirmed by MIC determination methods. Whereas, in present study the activity was confirmed only by smear test and biochemical analysis. Similar antitubercular properties of *G. glabra* has been reported by Vivek *et al.,* 2008 in ethanolic extract at a MIC of 500µg/ml on H37Ra and H37Rv strains of *M. tuberculosis*.

The Maximum Inhibitory Concentration (MIC) of 80% methanolic extracts of root of *C. aurea*, seeds of *O. basilicum*, leaves of *A. abyssinica*, *C. macrostachyus* and *E. camaldulensis* ranged between 25–100 µg/mL and 12.5-75 µg/mL, 25–100 µg/mL and 25–50 µg/mL, 6.25-50 µg/mL and 12.5-50 µg/mL, 12.5-100 µg/mL and 18.25-50 µg/mL and 6.25-50 µg/mL and 12.5-50 µg/mL, respectively for *M. tuberculosis* and *M. bovis* strains was described by Gemechu *et al.,* 2013. It might be due to ozono lysis of ionone ring in the structure which results in formation of two geranic acid or due to the inhibition of matrix metallo proteins by Beta-Ionone. The antimycobacterial activity of *S.braciata* was evaluated to explore the pharmacological potential of novel drug for tuberculosis. Further, the study has to be focused towards *invivo* testing to study the mechanism of action of selected lead compound in mice models.

5. Conclusion

The present pharmacognostic data highlight the acquaintance of quality and identity of both the plants *Sesuvium portulacastrum* and *Salicornia brachiata*. The complete results of the present word afford sympathetic information on the consumption of some medicinal plants against tuberculosis treatment. Both plants act as a prospective source of anti-TB natural compound and further research to develop novel anti-TB agents against sensitive and drug resistant strains of *M. tuberculosis* is essential.

Acknowledgement

The authors express their gratitude to Dr Malathi, Department of Microbiology, Sri

Shivani College of Pharmacy, Warangal, India and thank the authorities of Department of Biomedical Science, Alagappa University for the use of Research facilities and providing good support towards the completion of the work.

References

Giri, C., Ochieng, E., Tieszen, L.L., Zhu, Z., Singh, A., Loveland, T., Masek, J. and **Duke, N.** (2010) Status and distribution of mangrove forests of the world using earth observation satellite data, *Global Ecology and Biogeography*, **20** (1): 154–159.

Duke, N.C. and **Schmitt, K.** (2015). *Mangroves: Unusual forest at the seas edge.* Tropical Forestry Handbook. 1-24.

Lonard, R.I. and Judd, F. (1997) The Biological flora of coastal dunes and wetlands *Sesuvium portulacastrum* (L), *Journal of Coastal Research,* **13** (1): 96-104.

Lokhande, V., Nikam, Td., Patade, V.Y. and **Ahire, M.L.** (2011) Effects of optimal and supra-optimal salinity stress on antioxidative defence, osmolytes and *in vitro* growth responses in Sesuvium portulacastrum L, *Plant Cell Tissue and Organ Culture,* **104** (1): 41-49.

Patnaik, C., Sahu B. P. and **Gouda P.** (2016) Salicornia brachiata: Isolation of 7-0-β -D-glucopyranosyl-6-methoxychromone and 7-Hydroxy-6-methoxychromone from Ethanolic Plant Extract and Antimicrobial Studies. *International Journal of Science Research and Education,* **4** (8): 5665-5673.

Krishnaiah, D., Sarbatly, R. and **Nithyanandam, RR.** (2011) A review of the antioxidant potential of medicinal plant species. *Food Bioprod Process*. **89**, 217–233.

Geetha, T.S. and **Geetha, N.** (2014) Phytochemical screening, Quantitative analysis of primary and secondary metabolites of Cymbopogancitratus (DC) stapf. Leaves from kodaikanal hills, Tamil nadu, *International Journal of PharmTechRsearch.* **6** (2): 521- 529.

Siddhuraju, P. and Becker, K. (2003) Antioxidant properties of various solvent extracts of total phenoliconstituents from three different agroclimatic origins of Drumstick tree (MoringaoleiferaLam.) leaves. *Journal of Agricultural Food Chemistry*, **51:** 2144 –2155.

Mukharjee, P. K. (2008) *Quality Control of Herbal Drugs.* New Delhi: Business Horizons Pharmaceutical Publishers; 186.

Gautam, A., Kashyap, S. J., Sharma, P. K., Garg, V. P., Visht, S. and **Kumar, N.** (2010). Identification, evaluation and standardization of herbal drugs: an overview, *Der Pharmacia Lettre,* **2** (6): 302-315.

Ahmad, T., Singh, S. B. and **Pandey, S.** (2013). Phytochemical Screening and Physicochemical Parameters of Crude Drugs: A Brief Review, *International Journal of Pharma Research & Review.* **2** (12): 53-60.

Mritunjay Kumar, Prodyut Mondal, Sudarshana Borah and **Kabita Mahato.** (2013) Physico-chemical evaluation, preliminary phytochemical investigation, fluorescence and TLC analysis of leaves of the plant *Lasia spinosa* (lour) Thwaites, *International Journal of Pharmacy and Pharmaceutical Sciences*. **5** (2): 306-310.

Suriyavathana, M., Roopavathi, I. and **Vinu Vijayan.** (2016) Phytochemical characterization of *Triticum Aestivum* (Wheat grass), *Journal of Pharmacognosy and Phytochemistry.* **5** (1): 283-286.

Kahkonen, M. P., Hopia, A. I., Vuorela, H. J., Rauha, J. P., Pihlaja, K., Kjala, T. S. and **Heinonen, M.** (1999) Antioxidant activity of plant extracts containing phenolic compounds, *Journal Agriculture Food Chemistry,* **47** (10): 3954 – 62.

Govindasamy, C., Kannan, L. and **Azariah, J.** (2000) Seasonal variation in physico-chemical properties and primary production in the coastal water biotopes of Coromandel coast, India, *Journal of Environmental Biology,* **21:** 1-7.

Mensah, J.K., Okoli, R.I., Ohaju-Obodo, J.O. and **Eifediyi, K.** (2008) Phytochemical, nutritional and medical properties of some leafy vegetables consumed by Edo people of Nigeria, *African Journal of Biotechnology,* **7:** 2304-2309.

Banerjee, D. (2008) Responses of pathogenic and nonpathogenic yeast species to steroids reveal the functioning and evolution of multidrug resistance transcriptional networks, *Eukaryotic Cell,* **7** (1): 68-77.

Kathiresan, K. (1990) *Prospects of tissue culture studies in mangroves.* In "Advances in Forestry Research" (Ram Parkash, ed.), Vol. 6, pp. 143-151. International Book Distributors, Dehra dun, India.

Ravi, A.V. and **Kathiresan, K.** (1990) Seasonal variation in gallotannin from mangroves, *Indian Journal of Marine Sciences,* **19** (3): 224-225.

Bravo, A., Sarabia, S., Lopez, L., Ontiveros, H., Abarca, C., Ortiz, A., Ortiz, M., Lina, L., Villalobos, F.J., Peña, G., Nuñez-Valdez, M.E., Soberón, M. and **Quintero, R.** (1998) Characterization of cry genes in a Mexican Bacillus thuringiensis strain collection, *Applied Environmental Microbiology,* **64** (12): 4965-4972.

Crozier, A., Lean, M.E.J., McDonald, M.S. and **Black, C.** (1997) Quantitative Analysis of the Flavonoid Content of Commercial Tomatoes, Onions, Lettuce, and Celery, *Journal of Agricultural and Food Chemistry,* **45** (3): 590–595.

Boyer, J., Badis, G., Fairhead, C., Talla, E., Hantraye, F., Fabre, E., Fischer, G., Hennequin, C., Koszul, R., Lafontaine, I., Ozier-Kalogeropoulos, O., Ricchetti, M., Richard, G.F., Thierry, A. and **Dujon, B.** (2004) Large-scale exploration of growth inhibition caused by overexpression of genomic fragments in *Saccharomyces cerevisiae*, *Genome Biology,* **5** (9): R72.

Kroon, H., De., Huber, H., Stuefer, J.F. and **Van Groenendael, J.M.** (2005). A modular concept of phenotypic plasticity in plants, *New Phytologist*, **166** (1): 73-82.

Spalding, M. D., Kainuma, M. and **Collins, L.** (2010) *World Atlas of Mangroves.* 319 pp. (Earthscan).

Hassan, N. S., Thiede, J. and **Liede-Schumann, S.** (2005) Phylogenetic analysis of Sesuvioideae (Aizoaceae) inferred from nrDNA internal transcribed spacer (ITS) sequences and morphological data, *Plant Systematics and Evolution,* **255:** 121–143.

Chandrasekaran, M., Senthilkumar, A. and **Venkatesalu, V.** (2011) Antibacterial and antifungal efficacy of fatty acid methy l esters from the leaves of *Sesuvium portulacastrum* L, *European Review for Medical and Pharmacological Sciences,* **15** (7): 775-780.

Michael, L.M., Mazuru, G., Nyasha, G. and **Godfred, H.** (2006) Chemical composition and biological activities of essential oil from the leaves of *Sesuvium portulacastrum*, *Journal of Ethnopharmacology,* **103**: 85-90.

Sheela, D. and **Udhayakumari, F.** (2014) Hepatoprotective and antioxidant activity of *Sesuvium portulacastrum* whole plant methanolic extracts against ccl4–induced liver injury in rats, *Journal of Science,* **4** (3): 156-161.

Suganya, V., Anuradha, V., Syed Ali, M., Sangeetha, P. and **Bhuvana, P.** (2017) *In vitro* antioxidant activity of micro encapsulated and non-encapsulated astaxanthin, *Asian Journal of Science and Technology,* **8** (11): 6391-6404.

Suganya, V., Anuradha, V., Syed Ali, M., Sangeetha, P. and **Bhuvana, P.** 2017. *In vitro* anti-inflammatory activity of microencapsulated and non-encapsulated astaxanthin, *International Journal of ChemTech Research,* **10** (10): 186-195.

Murahari, D., Tanniru, S., Poonem, L., Paramesh, A., Sudheer Kumar, K., Jojula, M. and **Gunda, S.** (2018) Anti- mycobacterial screening methods for new compounds identification, *European Journal of Biomedical and Pharmaceutical Sciences,* **5** (6): 584-589.

Sofowara. (1982) *Medicinal plants and traditional medicine in Africa.* New York: John Wiley and sons, 1-10.

Vilioglu, Y.S., Mazza, G., Gao, L. and **Oomah, B.D.** (1998) Antioxidant Activity and Total Phenolics in Selected Fruits, Vegetables, and Grain Products, *Journal of Food Chem,* **46** (10): 4113-4117.

Barlow, S.M. (1990) *Toxicology aspects of antioxidants used as food additives.* In: Hudson BJF, ed., Food Antioxidants. London, Elsevier, pp. 253–307.

Xu, D.P., Li, Y., Meng, X., Zhou, T., Zhou, Y., Zheng, J., Zhang, J.J. and **Li, H.B.** (2017) Natural Antioxidants in Foods and Medicinal Plants: Extraction, Assessment and Resources, *International Journal of Molecular Science,* **18** (1): 96.

Kim, Y.J., Kim, Y.A. and **Yokozawa, T.** (2009) Protection against oxidative stress, inflammation, and apoptosis of high-glucose-exposed proximal tubular epithelial cells by astaxanthin, *Journal of Agricultural and Food Chemistry*, **57** (19): 8793-8797.

Umamaheswari, M. and **Chatterjee, T.K.** (2008) *In vitro* antioxidant activities of the fractions of *Coccin niagrandis L*. leaf extract, *African Journal of Traditional Complementary and Alternative Medicine,* **5:** 61-73.

Nunes, P.X., Silva, S.F., Guedes, R.J. and **Almeida, S.** (2012) Biological oxidations and antioxidant activity of natural products, *Phytochemicals as nutraceuticals-Global Approaches to Their Role in Nutrition and Health,* 1-20.

Krishnaiah, D., Sarbatly, R. and **Nithyanandam, R.R.** (2011a) A review of the antioxidant potential of medicinal plant species, *Food Bio product Process,* **89** (3): 217–233.

Alves, C.Q., David, J.M., David, J.P., Bahia, M.V. and **Aguiar, R.M.** (2010) Methods for determination of *in vitro* antioxidant activity for extracts and organic compounds, *Quimica Nova,* **33** (10): 2202-2210.

Meyer, A.S. and **Isaksen, A.** (1995) Application of enzymes as food antioxidant, *Trends in Food Science & Technology,* **6** (9): 300-304.

Sharififar, F., Dehghn-Nudeh, G. and **Mirtajaldini, M.** (2009) Major Flavonoids with Antioxidant Activity from *Teucrium polium L, Food Chemistry,* **112:** 885-888.

Gülçin, I., Berashvili, D. and **Gepdiremen, A.** (20050 Antiradical and antioxidant activity of total anthocyanins from *Perilla pankinensis decne*. *Journal of Ethnopharmacology.* **101** (1-3): 287-93.

Sahreen, S., Khan, M. R. and **Khan, R. A.** (2017) Evaluation of antioxidant profile of various solvent extracts of *Carissa opaca* leaves: an edible plant, *Chemistry Center Journal,* **11**: 83.

Gordon, M. H. (1990) The Mechanism of Antioxidant Action *in Vitro*. *Food Antioxidants,* 1-18.

Ao, C., Li, A., Elzaawely, A.A., Xuan, D.T. and **Twata, S.** (2008) Evaluation of antioxidant and antibacterial activities of *Ficus microcarpa*L. fill extract, *Food Control,* **19:** 940–948.

Di Carlo, G., Mascolo, N., Izzo, A.A. and **Capasso, F.** (1999) Flavonoids: old and new aspects of a class of natural therapeutic drugs, *Life science,* **65** (4): 337-353.

Bravo, L. (1998) Polyphenols: chemistry, dietary sources, metabolism, and nutritional significance, *Nutrition Review,* **56** (11): 317-33.

Sahreen, S., Khan, M. R. and **Khan, R. A.** (2011) Estimation of flavonoids and evaluation of protective effect of Carissa opaca Stapf ex Haines fruit against CCl(4) induced nephrotoxicity in rat, *Food Chemistry and Toxicology,*

Halliwell, B. (1989) Free radicals, reactive oxygen species and human disease: a critical evaluation with special reference to atherosclerosis, *British Journal of Experimental Pathology,* **70** (6): 737-757.

Ruberto, M. T., Baratta, S. G. and **Deans, H. J. D.** (2000) Dorman Antioxidant and antimicrobial activity of *Foeniculum vulgare* and *Crithmum maritimum* essential oils, *Planta Medica,* **66:** 687-693.

Gemechu, A., Giday, M., Worku, A. and **Ameni, G.** (2013).*In vitro* anti-mycobacterial activity of selected medicinal plants against *Mycobacterium tuberculosis* and *Mycobacterium bovis* strains, *BMC Complementary and Alternative Medicine,* **13:** 291.

تحديد العقاقير ومضادات الأكسدة في المختبر ومضادات الالتهاب والنشاط المضاد للبكتيريا لنبات المستنقعات الملحية: سيسوفيوم بورتولاكاستروم وساليكورنيا براشياتا

أنورادها فينكاترامانا، وسيد علي محمد يعقوب*، ويوغانانث ناجاراجانب، وملاثي جوجولاك، وسوغانيا فاسوديفاند

قسم الكيمياء الحيوية، كلية محمد ساتاك للفنون والعلوم، تشيناي، الهند aPG & Research

*قسم التكنولوجيا الحيوية، كلية محمد سحق للفنون والعلوم، تشيناي. الهند bPG & Research **

قسم الكيمياء الحيوية، كلية شريماتي إنديرا .د قسم الأحياء الدقيقة، كلية سري شيفاني للصيدلة، وارانجال، الهند غاندي، تريشي، تاميل نادو، الهند

syedmicro555@gmail.com

المستخلص. المانغروف عبارة عن أشجار أو شجيرات كبيرة لها تكيفات خاصة للبقاء في هذه البيئة وتنمو داخل منطقة المد والجزر في المناطق الاستوائية وشبه الاستوائية. *Sesuvium portulacastrum* (seapurslane) هو نبات عشبي، معمر، ثنائي التفرع، نبات ملحي سريع النمو ينتمي إلى عائلة *Aizoaceae*. *Salicornia brachiata* Roxb، نبات ملحي، يُعرف باسم الهليون البحري ويستخدم على نطاق واسع كمواد غذائية في العديد من البلدان. ثم أجريت دراسات في المختبر مثل مضادات الأكسدة ومضادات الالتهابات ومقايسة مضادات البكتيريا. تم العثور على قيم IC50 من *Salicornia brachiata* و*Sesuvium portulacastru* لتكون ٢٨٨,١٦٦ و٣٦٩,٤٥١ و٣٦٩,٧٦٤ ميكروجرام / مل لنشاط تنظيف DPPH. تم الكشف عن وجود العديد من المستقلبات الأولية والثانوية في هذه الدراسة. كما أظهر نشاطًا أفضل في المختبر وكان أكثر النباتات نشاطًا ضد سلالة MDRTB وMTB وH37RV. تثبت هذه الدراسة الاستخدام الطبي للنباتات في علاج السل والتي لها تأثير واعد ضد MDRTB وMTB وH37RV.

الكلمات المفتاحية: *Sesuvium portulacastrum*، *Salicornia brachiata*، نشاط مضاد للجراثيم، MDRTB، MTB، H37RV.