Research Article

# Phytochemical Screening, Antibacterial, Antioxidant and Anthelmintic Activities of *Suaeda nudiflora* (Willd.) Moq.

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## ABSTRACT

The present study was aimed to investigate phytochemical screening, total phenolic and flavonoid contents, *invitro* antibacterial, antioxidant and anthelmintic activities of different solvent extracts of *Suaeda nudiflora*. Screening for different phytochemicals was carried out by using conventional protocols. Estimated the total phenolic and flavonoid contents by Folin-Ciocalteu and Aluminium chloride methods, respectively. The antibacterial activity was performed by agar well diffusion method. The antioxidant assay was carried out by DPPH (2, 2-diphenyl-1-picryl-hydrazyl) method. Using standard protocol the anthelmintic activity was carried out. The test sample from whole plant in different solvents showed positive results for the majority of phytochemicals screened. Ethyl extract of the plant exhibited better antibacterial activity on the majority of Gram positive and Gram negative test organisms followed by acetone and chloroform extracts. With respect to some test organisms, the crude extract of ethyl acetate caused greater zones of inhibition than the pure streptomycin. Ethyl acetate and acetone extracts exhibited strong free radical scavenging activity than the standard ascorbic acid at different concentrations. Acetone extract showed very good anthelmintic activity than positive control albendazole at same concentration (40mg/ml). The paralysis time and death time of acetone extract were 121.5 and 142.8 minutes, respectively which are less than that of albendazole. In this study, the plant exhibited the presence of different phytochemicals and the plant extracts showed antibacterial, antioxidant and anthelmintic activities suggesting that the plant is possessing some potential bioactive compounds.

**Keywords:** *Suaeda nudiflora*, Antioxidant activity, Phytochemicals, Antibacterial activity, Anthelmintic activity.

## INTRODUCTION

During the last few decades, there has been an increasing interest in the study of traditional plants and their medicinal value in different parts of the world [1]. In recent years, multiple drug resistance in human pathogenic microorganisms has developed due to indiscriminate use of commercial antimicrobial drugs commonly used in treatment of infectious diseases. This situation forced the scientists to search for new antimicrobial substances from various sources like medicinal plants which are good sources of novel antimicrobial agents[2]. Free radicals, the highly reactive compounds, are chemical species associated with an odd or unpaired electron and can be formed when oxygen interacts with certain molecules. They are neutral, short lived, unstable and highly reactive to pair with the odd electron and finally achieve stable configuration. Once formed, these highly reactive radicals can start a chain reaction. Free radicals generated by these reactions are capable of attacking the healthy cells of the body, causing them to lose their structure and function[3]. Free radicals were reported as being capable of damaging a lot of cellular components such as proteins, lipids and DNA [4]. Antioxidants may offer resistance against oxidative stress by scavenging free radicals, lipid peroxidation and many other mechanisms thus prevent disease [5,6]. The use of traditional medicine is widespread and plants provide a large source of natural antioxidants that might serve as leads for the development of novel drugs. Therefore, investigations of natural antioxidants and bioactive compounds for preservation of traditional medicines and use in treating certain human diseases have received much attention [7]. Plants are the natural sources for their property of having antioxidants, including polyphenolic compounds, tocopherols, vitamin C and carotenoids, and are attracting the food industry. These compounds are the replacements for synthetic ones, whose usage is being restricted due to their harmful effects on human health. The natural antioxidants from the plant source protect the body from free radicals. BHA (Butylated hydroxyl anisole) and BHT (Butylated hydroxyl toluene) are the very effective synthetic antioxidants but they are toxic to human health and need to be replaced by natural antioxidants. So, there is a necessity for identifying alternative natural and safe source of antioxidants and the search for natural antioxidants, especially of plant origin has been increased in recent years[8]. Helminth infections are among the most common infections in man, affecting a large proportion of the world's population. For the study of anthelmintic activity, adult earthworms were used because of their resemblance to intestinal round worms in anatomical and physiological features. *Suaeda nudiflora* is a mangrove plant which is used as a leafy vegetable. Commonly found on salt marshes and tidal banks. It belongs to the chenopodiaceae family. The vernacular name of this plant is "elakura". In the present investigation, we made an attempt to evaluate the phytochemical screening, antibacterial activity and compare the antioxidant activity of different solvent extracts of *Suaeda nudiflora* with

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commercial antioxidant ascorbic acid as positive control. In addition, this study also evaluated the total phenolic and total flavonoid contents of different solvent extracts and also tested the anthelmintic activity.

## MATERIALS AND METHODS

### Chemicals and reagents

2, 2-diphenyl-1-picryl-hydrazyl (DPPH) was obtained from sigma-Aldrich, Folin-Ciocalteu reagent from Qualigens, Catechol from CDH and all the solvents from Merck. The remaining chemicals which were used in the present study were analytical grade.

### Preparation of the plant extracts

*Suaeda nudiflora* plant was collected from a place nearby Nizampatnam, Andhra Pradesh. The total plant was thoroughly washed, cut into small pieces and air dried in shade. The dried plant material was grounded to a coarse powder by means of electrical grinder. The dried powdered plant material was extracted in different solvents viz., Hexane, Benzene Chloroform, Ethyl acetate, Acetone and Methanol. The resulted extracts were filtered and then concentrated in roto evaporator and the crude extracts were preserved in sterile air tight containers for further analysis.

### Preliminary phytochemical screening

Phytochemical screening was evaluated by the following tests[9].

#### *Test for flavonoids*

a) Ferric chloride test

Two ml of the test solution was boiled with distilled water and filtered. Then, few drops of 10% ferric chloride solution were added to the 2 ml of filtrate. A greenish-blue or violet coloration indicates the presence of a phenolic hydroxyl group.

b) Shinoda's test

Five grams of each extract was dissolved in ethanol, warmed and then filtered. Small pieces of magnesium chips were then added to the filtrate followed by few drops of conc. HCl. The pink, orange, or red to purple coloration indicates the presence of flavonoids.

c) Sodium hydroxide test

Extract of 0.2 gm was dissolved in water and filtered. To this, 2 ml of the 10% aqueous sodium hydroxide was added to produce yellow coloration. A change in color from yellow to colorless on addition of dilute hydrochloric acid was the indication for the presence of flavonoids.

d) Leadacetate test

Extract of 0.5 gm was dissolved in water and filtered. To the 5 ml of each filtrate, 3 ml of lead acetate solution was added. Appearance of a buff-colored precipitate indicates the presence of flavonoids.

#### *Test for alkaloids*

Five grams of crude powder was stirred with 1% aqueous HCl on water bath and then filtered. To the 1 ml filtrate, few drops of Dragendroff's reagent were added. Orange-Red precipitate was taken as positive. To another 1 ml filtrate, few drops of Mayer's reagent were added and appearance of buff- colored precipitate will be taken as presence of alkaloids.

#### *Test for soluble starch*

Crude extract of 0.2 gm was boiled in 1 ml of 5% KOH, cooled and acidified with $H_2SO_4$. Yellow coloration indicates the presence of soluble starch.

#### *Test for Saponins*

Crude powder of 0.5 g was shaken with water in a test tube and it warmed in a water bath. The persistent froth indicates the presence of saponins.

#### *Test for terpenoids*

Five grams of crude extract was dissolved in ethanol. To this, 1 ml of acetic acid was added followed by conc. $H_2SO_4$. A change in color from pink to violet confirms the presence of terpenoids.

#### *Test for steroids*

a) Salkowskii test

In 2 ml of chloroform, 0.2 g of extract was dissolved and added the conc. $H_2SO_4$. The development of reddish brown color at inter phase indicates the presence of steroids.

b) Keller-Killiani test

To 0.5 ml of test solution, 2 ml of 3.5% $FeCl_3$, small amount of glacial acetic acid and 2 ml of conc. $H_2SO_4$ were added carefully. Appearance of reddish brown ring at inter phase is a positive indication for the presence of steroids.

c) Liebermann-Burchard test

To 0.2 g of each extract, 2 ml of acetic acid was added and the solution was cooled well in ice followed by the addition of conc. $H_2SO_4$ carefully. Color development from violet to blue or bluish-green indicates the presence of a steroidal ring (i.e. aglycone portion of cardiac glycoside).

#### *Test for carbohydrates*

a) Molisch's test

Two ml of *Molisch*'s reagent was added to the extract dissolved in distilled water and 1 ml of conc. $H_2SO_4$ was dispensed along the walls of the test tube. The mixture was allowed to stand for two minutes and then diluted with 5 ml of distilled water. Formation of a dull violet color at the inter phase of the two layers indicates the positive test for carbohydrates.

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b) Fehling's test (for free reducing sugars)

The crude extracts were treated with 5.0 ml of Fehling's solution (A & B) and kept in boiling water bath. The formation of yellow or red color precipitate indicates the presence of free reducing sugars.

c) Fehling's test (for Combined Reducing Sugars)

Extract of 0.5 g was hydrolyzed by boiling with 5 ml of dilute hydrochloric acid and the resulting solution neutralized with sodium hydroxide solution. To this, few drops of Fehling's solution were added and then heated on a water bath for 2 minutes. Appearance of a reddish-brown precipitate of cuprous oxide indicates the presence of combined reducing sugars.

d) Barfoed's test (for monosaccharide)

In distilled water, 0.5 g of the extract was dissolved and filtered. To 1 ml of the filtrate, 1 ml of Barfoed's reagent was added and then heated on a water bath for 2 minutes. Reddish precipitate of cuprous oxide formation is the positive test for the presence of monosaccharide.

***Test for tannins***

Crude extract of 0.5 g was stirred with 10 ml of distilled water and then filtered. Few drops of 1% ferric chloride solution were added to 2 ml of the filtrate. Occurrence of a blue-black, green or blue-green precipitate indicates the presence of tannins.

a) Borntrager's Test

Extract of 0.2 g was shaken with 10 ml of benzene and then filtered. To the filtrate, 5 ml of 10% ammonia solution was added and then shaken the tube well. Appearance of pink, red or violet color in the ammoniacal (lower) phase indicates the presence of free anthraquinones.

b) Phlonatanins test

To 0.2g of extract, 1% HCl solution was added. Formation of red precipitate indicates the presence of tannins.

***Estimation of total phenolics***

Total phenolic content of different solvent extracts of *Suaeda nudiflora* was determined by the modified Folin-Ciocalteu method [10]. One ml of Folin-Ciocalteu reagent and 2 ml of $Na_2CO_3$ (2% W/V) were added to 1 ml of plant extract solution (1mg/ml in DMSO). The reaction mixture was incubated at $45^0$C with shaking at 120 rpm for 15 minutes. After incubation, absorbance of the samples was measured at 765 nm using UV-Visible spectrophotometer. Results were expressed as milligrams of catechol equivalent/g of plant extract. The same procedure was used for making standard curve using catechol.

***Estimation of total flavonoids***

Total flavonoid content was estimated by following Aluminum chloride method [11]. One ml of sample (1 mg/ml in DMSO) was mixed with 3 ml of methanol, 0.2 ml of 10% aluminum chloride, 0.2 ml of 1 M potassium acetate and 5.6 ml of distilled water. The reaction mixture was kept for incubation at room temperature for 30 minutes. After incubation the absorbance of the reaction mixture was measured at 420 nm using UV-Visible spectrophotometer. The total flavonoid content was determined from standard curve made by catechin as standard. The concentration of total flavonoids was expressed as mg of catechin equivalent/g of plant extract.

**Antibacterial activity of the plant extracts**

***Microorganisms used***

The antibacterial activity of the crude extracts was determined against both Gram positive and Gram negative bacteria. Nine Gram positive bacteria namely *Micrococcus luteus* MTCC 106, *Arthrobacter protophormiae* MTCC 2682, *Rhodococcus rhodochrous* MTCC 265, *Bacillus subtilis* MTCC 441, *Staphylococcus aureus* MTCC 737, *Bacillus megaterium* MTCC 428, *Enterococcus faecalis* MTCC 439, *Streptococcus mutans* MTCC 497 and *Lactobacillus acidophilus* MTCC 10307 and six Gram negative bacteria viz., *Alcaligens faecalis* MTCC 126, *Salmonella enterica* MTCC 3858, *Proteus vulgaris* MTCC 426, *Proteus mirabilis* MTCC 425, *Pseudomonas aeruginosa* MTCC 1688 and *Enterobacter aerogenes* MTCC 10208 were used in the study.

***Antibacterial screening by agar well diffusion method***

Antibacterial activity was determined by agar well diffusion method [12]. Bacterial suspensions of different bacteria were prepared by using 24 hours old bacterial cultures. After solidification of agar medium, 6mm diameter wells were punched in agar medium with a sterile cork borer. Streptomycin standard antibiotic was used as positive control in the concentration of 10µg/ml DMSO. A minute quantity of sterile agar suspension was added to the well. The sample of 100 µl, prepared by dissolving 100mg of sample in 1 ml of DMSO, was added to each well. In a separate well, DMSO was also dispensed to maintain the control. The plates were incubated at $37^0$ C for 24 hrs. After incubation, the diameter of the inhibition zone was measured. For each sample and bacterial species, triplicates were maintained.

***Determination of MIC and MBC***

Minimal inhibitory concentration (MIC) was determined by using broth dilution method[12]. Minimal inhibitory concentration and minimal bactericidal concentration (MBC) was seen with different concentrations viz., 12.5mg, 25 mg, 50mg, 75mg and 100mg on those bacterial strains which showed zones of inhibition against the plant extracts.

***In vitro* antioxidant assay**

***2, 2-diphenyl-1-picryl hydrazyl (DPPH) Free radical scavenging activity***

The DPPH free radical scavenging activity of the different extracts was measured according to the method of Ai Lan


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Chew *et. al.*[13]. The crude extracts in different concentrations viz., 100 µg/ml, 200 µg/ml, 300 µg/ml, 400 µg/ml and 500 µg/ml were prepared in DMSO. One ml of each concentrations was mixed with 4 ml of the 0.004% (w/v) solution of DPPH prepared in methanol. The reaction mixture was kept for incubation in dark for 30 minutes. Methanol was used as control and Ascorbic acid was used as positive control. The absorbance was measured at 517 nm. The DPPH scavenging activity (%) was calculated by using the following formula

DPPH scavenging activity (%) = $[(A_0 - As) / A_0] \times 100$,

Where, $A_0$ .. absorbance of the control

As -- absorbance of the plant sample

### Anthelmintic activity

The anthelmintic activity was evaluated as per the standard method [14]. Tween 80 of 0.1% was freshly prepared in normal saline water. The crude extracts, obtained through different solvents, of 40mg/ml concentrations were prepared in 0.1 % tween 80. Ten ml aliquots of these extracts were dispensed in individual petriplates and placed six earthworms in each plate. The standard drug Albendazole was prepared in same concentration (40mg/ml) and used as positive control. One plate with only normal saline was maintained as control. The time taken for paralysis as well as death of individual worms in each plate were noted.

## RESULTS

### Phytochemical screening

The results of the phytochemical screening are given in table-1. Of the phytochemicals tested for, carbohydrates were present in all the solvent extracts of the plant. Monosachharides were found in ethyl acetate, acetone and methanol extracts only, free reducing sugars were positive in hexane, benzene and methanol extracts, likewise combined reducing sugars were present in hexane, benzene, chloroform and methanol extracts. Both tannins and free anthraquinones were positive in acetone and methanol extracts. Steroids and cardiac glycosides were found in benzene, chloroform, acetone and methanol extracts. Terpenoids were present in all solvent extracts except the hexane. Flavonoids were present in all the extracts tested except the benzene. Saponins were not found in benzene and chloroform extracts, whereas the soluble starch was absent in benzene, ethylacetate and methanol. Alkaloids were found only in ethylacetate and acetone extracts.

**Table 1:** Phytochemical analysis of *Suaeda nudiflora* total plant extracts in different solvents

| Phytochemicals | H | B | C | E | A | M |
|---|---|---|---|---|---|---|
| Carbohydrates | + | + | + | + | + | + |
| Monosaccharides | -- | -- | -- | + | + | + |
| Free reducing sugars | ++ | ++ | -- | -- | -- | ++ |
| Combined reducing sugars | + | ++ | + | -- | -- | + |
| Tannins | -- | -- | -- | -- | + | + |
| Free anthraquinones | -- | -- | -- | -- | + | + |
| Steroids | -- | + | + | -- | + | + |
| Cardiac glycosides | -- | + | + | -- | + | + |
| Terpenoids | -- | + | + | + | + | + |
| Saponins | + | -- | -- | ++ | + | + |
| Flavonoids | + | + | -- | + | ++ | + |
| Soluble starch | + | -- | + | -- | + | -- |
| Alkaloids | -- | -- | -- | + | + | -- |

H - Hexane; B - Benzene; C - Chloroform; E - Ethyl Acetate; A - Acetone; M - Methanol

### Total phenolic and flavonoid contents

Total phenolic and flavonoid contents of *S.nudiflora* total plant of different solvent extracts are given in table-2. The total phenolic content of hexane, benzene, chloroform, ethyl acetate, acetone and methanol extracts were found to be 28.66, 35.00, 24.00, 68.00, 61.66 and 43.66 µg of catechin /mg dry weight, respectively. And the total flavonoids of hexane, benzene, chloroform, ethyl acetate, acetone and methanol extracts of plant were 41.66, 12.00, 1.00, 10.00, 10.00, 11.00 µg of catechin /mg dry weight, respectively.

**Table 2:** Total Phenolic and total Flavonoid contents of different extracts of *Suaeda nudiflora*

| Plant extracts | Total phenolic content µg catechin /mg dry weight | Total flavonoid content µg catechin /mg dry weight |
|---|---|---|
| Hexane | 28.66 ± 0.57 | 41.66 ± 0.57 |
| Benzene | 35.00 ± 00 | 12.00 ± 00 |
| Chloroform | 24.00 ± 00 | 1.00 ± 00 |
| Ethyl acetate | 68.00 ± 00 | 10.00 ± 00 |
| Acetone | 61.66 ± 0.57 | 10.00 ± 00 |
| Methanol | 43.66 ± 0.57 | 11.00 ± 00 |

Values are the Mean ± SD of three replicates

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## Antibacterial activity

The different solvent extracts of *S. nudiflora* showed varied antibacterial activity against fifteen tested bacteria (Figures 1 and 2). Of all the solvent extracts used, ethyl acetate exhibited antibacterial activity on all the test organisms except *S. enterica* which was found resistant to all the solvent extracts. Ethyl acetate extract showed antibacterial activity which is either equal to or more than that of positive control (Streptomycin) on *B. subtilis, E. faecalis, S. aureus, P. aeruginosa, A. faecalis, and P. vulgaris.* The *P. aeruginosa* was found susceptible only to the ethyl acetate extract. Streptomycin has no effect on *R. rhodochrous* and *E. aerogens*, but chloroform, ethyl acetate and acetone extracts of the plant showed antibacterial activity on these two bacterial species. Next to the ethyl acetate, acetone and chloroform extracts exhibited positive results on majority of the test organisms.

The results of the MIC and MBC are given in table-3 The ethyl acetate extract of *S. nudiflora* total plant MIC values against *B. megaterium*, *S. aureus* and *P. vulgaris* are 25mg/ml and the MBC value was 50mg/ml. And, the MIC value against *A. protophormiae*, *B. subtilis*, *E. faecalis*, *S. mutans*, *A. faecalis*, *P. mirabilis* and *P. aeruginosa* was found to be 50mg/ml and MBC value was 75mg/ml. For *M. luteus*, *R.rhodochrous* and *E. aerogenes* the MIC value was 75mg/ml and the MBC value was 100mg/ml. Acetone extract of *S. nudiflora* total plant exhibited an MIC value of 50mg/ml against *A. protophormiae* and *E. faecalis*, and an MBC value of 75mg/ml. Whereas, the MIC and MBC values of acetone extract against *M. luteus*, *R. rhodochrous*, *B. subtilis*, *L. acidophilus*, *A. faecalis* and *E. aerogenes* were 75mg/ml and 100mg/ml, respectively.

**Table 3:** MIC and MBC values of total plant extracts of *Suaeda nudiflora*

| Test organisms | Ethyl acetate (mg) | | Acetone (mg) | |
|---|---|---|---|---|
| | MIC | MBC | MIC | MBC |
| *Micrococcus luteus* MTCC 106 | 75 | 100 | 75 | 100 |
| *Arthrobacter protophormiae* MTCC 2682 | 50 | 75 | 50 | 75 |
| *Rhodococcus rhodochrous* MTCC 265 | 75 | 100 | 75 | 100 |
| *Bacillus megaterium* MTCC 428 | 25 | 50 | -- | -- |
| *Bacillus subtilis* MTCC 441 | 50 | 75 | 75 | 100 |
| *Enterococcus faecalis* MTCC 439 | 50 | 75 | 50 | 75 |
| *Streptococcus mutans* MTCC 497 | 50 | 75 | -- | -- |
| *Staphylococcus aureus* MTCC 737 | 25 | 50 | -- | -- |
| *Lactobacillus acidophilus* MTCC 10307 | -- | -- | 75 | 100 |
| *Alcaligens faecalis* MTCC 126 | 50 | 75 | 75 | 100 |
| *Proteus mirabilis* MTCC 425 | 50 | 75 | -- | -- |
| *Proteus vulgaris* MTCC 426 | 25 | 50 | -- | -- |
| *Enterobacter aerogenes* MTCC 10208 | 75 | 100 | 75 | 100 |
| *Salmonella enterica* MTCC 3858 | -- | -- | -- | -- |
| *Pseudomonas aeruginosa* MTCC 1688 | 50 | 75 | -- | -- |

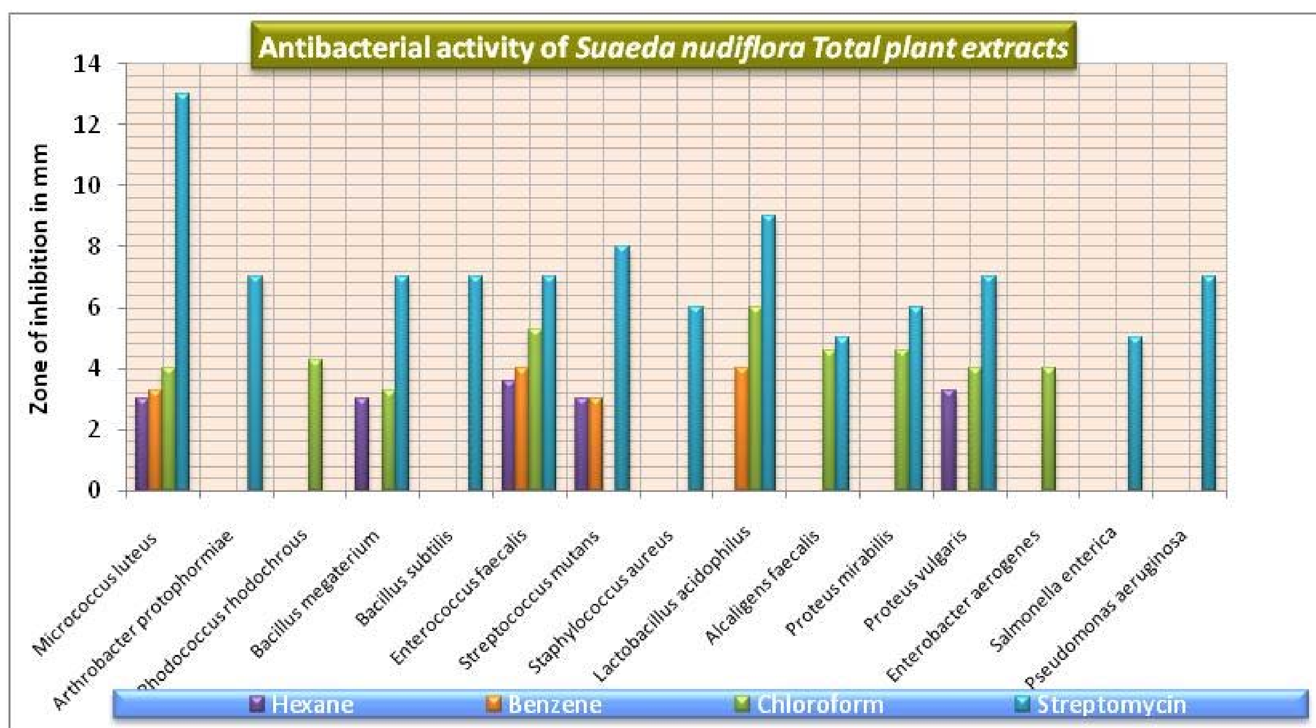


**Figure 1:** Antibacterial activity of total plant extracts of *Suaeda nudiflora*


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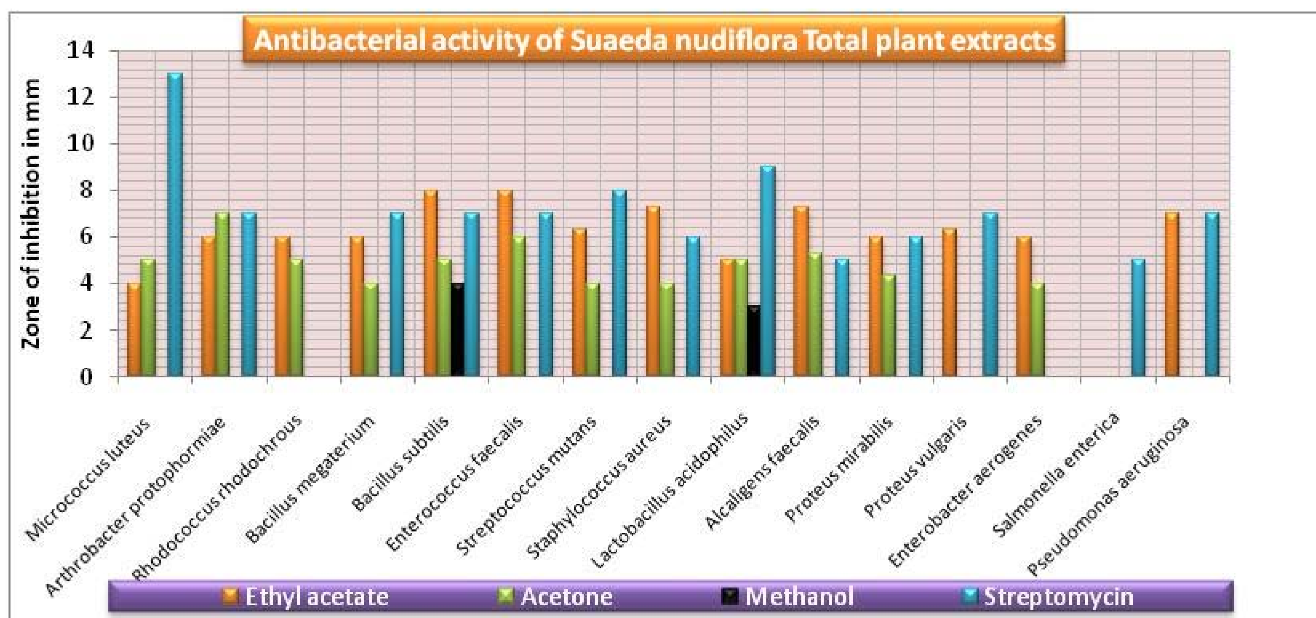


**Figure 2:** Antibacterial activity of total plant extracts of *Suaeda nudiflora*

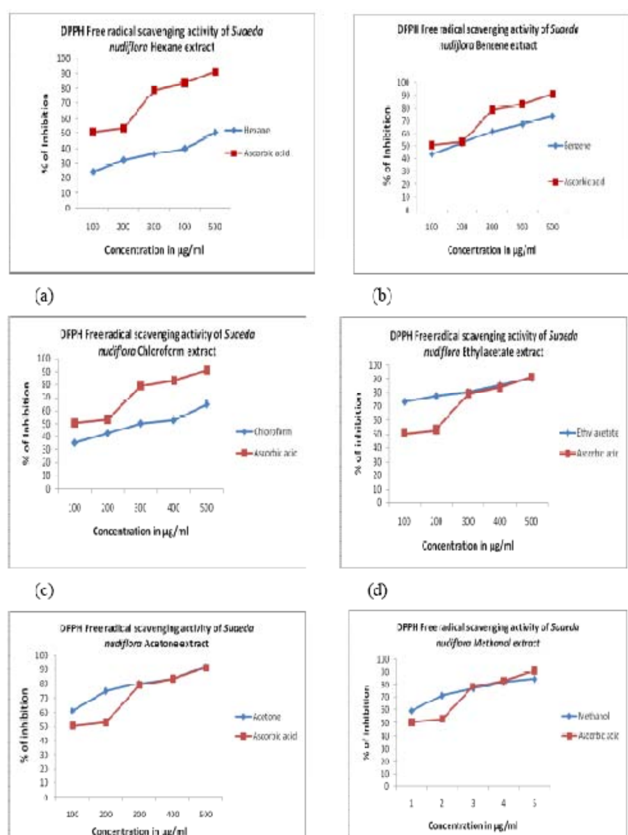


**Figure 3:** Antioxidant activity of different solvent extracts of *Saueda nudiflora*

### Free radical scavenging assay

The antioxidant activity of different extracts at different concentrations was plotted against positive control ascorbic acid (Figures-3a-f). The ethyl acetate, acetone and methanol extracts showed more free radical scavenging activity than the positive control ascorbic acid. Ethyl acetate and acetone fractions of different concentrations exhibited higher free radical scavenging activity than the control when compared to all other extracts. Methanol extract showed next higher scavenging activity, where as hexane, benzene and chloroform extracts revealed low free radical scavenging activity.

### Anthelmintic activity

Among the different solvent extracts of the plant, only acetone and ethyl acetate extracts showed the anthelmintic activity (table-4). And of these two extracts, acetone extract exhibited very good activity with lesser paralysis time and death time than the positive control, Albendazole. Though the ethyl acetate showed anthelmintic activity, it has taken more time for both paralysis and death of the worms than positive control. This is the first report on anthelmintic activity by *S. nudiflora*. However, the plant extracts of hexane, benzene and chloroform did not show any anthelmintic activity.

**Table 4:** Anthelmintic activity of different extracts of *Suaeda nudiflora*

| Sample | Concentration (mg/ml) | Paralysis time (min) | Death time (min) |
|---|---|---|---|
| Tween 80 (0.1 %) in normal saline | -- | -- | -- |
| Albendazole | 40 | 142.6 ± 2.3 | 175.5 ± 4.59 |
| Hexane extract | 40 | -- | -- |
| Benzene extract | 40 | -- | -- |
| Chloroform extract | 40 | -- | -- |
| Ethyl acetate extract | 40 | 182.6 ± 2.58 | 217.8 ± 2.99 |
| Acetone extract | 40 | 121.5 ± 2.25 | 142.8 ± 3.12 |
| Methanol extract | 40 | -- | -- |

Values are the Mean ± SD of three replicates

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## DISCUSSION

In the present investigation, the antioxidant properties, phytochemical analysis, antibacterial activity, total phenolic and flavonoid content and finally anthelmintic activity of different solvent extracts viz., hexane, benzene, chloroform, ethyl acetate, acetone and methanol extracts of *S.nudiflora* were studied. The results revealed the presence and/or absence of different phytochemicals, different levels of antioxidant, antibacterial and anthelmintic activities in different solvent extracts. Different phytochemicals present in the plants impart color, smell, flavor and protect them against herbivorous insecticides, vertebrates, fungi, pathogens and parasites[15]. Many plants have been investigated for the antioxidant activities in the past and the search is gradually increased in recent times since Reactive oxygen species (ROS) was the salient feature behind many dreadful diseases. Several anti-inflammatory, digestive, antinecrotic, neuroprotective and hepatoprotective drugs have recently been shown to have an antioxidant and/or radical scavenging mechanism as part of their activity [16-18]. To regulate the ROS levels, plant cells are evolved with complex enzymatic and nonenzymatic antioxidant defense mechanisms, which together help to control the cellular redox state under changing environmental conditions[19]. Phenols are very important plant constituents with multiple biological functions including antioxidant activity because of their radical scavenging ability due to their OH groups. The presence of flavonoids might be responsible for the antioxidant activity of the plants. In very recent years, flavonoids being potent free radical scavengers have attracted a tremendous interest as possible therapeutics against free radical mediated diseases [20]. Traditional medicinal practice has been known for centuries in many parts of the world for the treatment of various human ailments. The use of antibiotics has revolutionized the treatment of various bacterial infections. However, their indiscriminate use has led to an alarming increase in antibiotic resistance among microorganisms [21,22]. This resistance problem demands a renewed effort to be made for seeking antibacterial agents effective against pathogenic bacteria resistant to current antibiotics [23]. Plants are the important sources of potentially useful substances for the development of new chemotherapeutic agents. The first step towards achieving the goal for developing eco-friendly management of human infectious diseases is the in-vitro evaluation of plants for new biomolecules of plant origin that contains antimicrobial property. Various phytochemical compounds which are naturally present in plants as secondary metabolites have shown antibacterial activities [24-26]. Ethyl acetate extract showed a potential antibacterial activity than the positive control against eight organisms out of fifteen test organisms tested, and acetone extract had the strong antibacterial activity than the positive control against four test organisms tested. Muthazhagan *et. al.* [27] reported the antimicrobial activity of petroleum ether, ethyl acetate and methanol extracts of *Suaeda monoica* against both bacteria and fungi. The antibacterial activity against both gram-negative bacteria and gram-positive bacteria by acetone, ethanol, methanol and aqueous extracts of *Suaeda maritima* was also reported earlier [28].

Helminth infections are among the most widespread infections in humans, distressing a huge population of the world although the majority of infections due to helminths are generally restricted to tropical regions and cause enormous hazard to health and contribute to the prevalence of undernourishment, anaemia, eosinophilia and pneumonia[29-32]. Albendazole(ABZ),methyl [5-(propylthio)-I-H-benzimidazol-2yl] carbamate, is undoubtedly the most effective of the broad-spectrum anthelmintic agents [33,34]. In the present study, acetone extract of the *S. nudiflora* revealed the more anthelmintic activity than the standard drug Albendazole at same concentration and thisthe first report anthelmintic activity this plant. *S. nudiflora* plant extracts contained considerable levels of phenolic compounds and flavonoids. Different solvent extracts of this plant also exhibited antioxidant activity and ethyl acetate and acetone extracts showed a higher strength than the standard drug ascorbic acid.

## CONCLUSION

The present investigation has demonstrated the phytochemical analysis, antibacterial, antioxidant and anthelmintic activities of *S.nudiflora* plant extracts. All the extracts of *S.nudiflora* exhibited free radical scavenging activity and the presence of different phytochemicals like tannins, steroids, carbohydrates, flavonoids, soluble starch, alkaloids and terpenoids. Ethyl acetate, acetone and chloroform extracts have shown potential antibacterial activity against majority of Gram positive and Gram negative bacteria than the positive control. In addition, the acetone extract expressed a powerful anthelmintic activity than the standard drug Albendazole and to the best of our knowledge, this is the first report on the anthelmintic activity of this plant. And further studies need to be carried out for isolation and characterization of the chemical compound responsible for the activities exhibited by this plant.

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