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Original Article

In Vitro Antimicrobial, Antioxidant, and Phytochemical Studies of *Vernonia albicance* Leaves, from the Talakona Forest of Eastern Ghats, India

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ABSTRACT

The main aim of the present work is to study the in vitro antioxidant, antimicrobial, and phytochemical studies of *Vernonia albicans* DC (Syn. *Cyanthillium albicans* (DC.) H. Rob.) of the Asteraceae family. The plant was collected from Talakona forest in Chittoor District, Andhra Pradesh, India. The plant has very good medicinal values, particularly its leaves are used for skin diseases by the local tribal peoples. The plant extracts showed a significant antibacterial activity against both Gram-positive and Gram-negative bacterial strains, such as *Staphylococcus aureus* (Gram positive) and *Escherichia coli*, *Klebsiella pneumonia*, and *Pseudomonas aeruginosa* (Gram negative). The plant extracts were analyzed for the secondary metabolites such as alkaloids, terpenes, flavonoids, and phenolics, and the results were provided. The results suggest that the leaf extracts from *V. albicans* could be used as antimicrobial agent for treatment of various bacterial diseases.

Keywords: Antimicrobial, antioxidant activities, phytochemical studies, Vernonia albicans leaf extracts

Introduction

Medicinal plants have a high number of secondary metabolites, for instance, terpenes, flavonoids, alkaloids, and saponins, which gives them a therapeutic value. *Vernonia albicans* DC (Syn. *Cyanthillium albicans* (DC.) H. Rob., also known as Peddasahadevi (vernacular name), is a rare medicinal plant widely used as traditional medicine. It belongs to the Asteraceae family. This plant is generally present in West Africa, Nigeria, South Africa, and Zimbabwe. Its leaves and roots have been used for the treatment of diseases like stomach ache (infections), fever, kidney problems, and hiccups. The leaves are used as a flavor for soups due to their bitter nature; it has also been used as a laxative, for diarrhea, as a fertility inducer, and for cough and hepatitis. The infection caused by Platyhelminthes and nematodes was cured by the leaves (Egharevba et al., 2014). In addition, it is also used for curing filariasis (Girach et al., 1998) and eye diseases (Ratnam et al., 2010).

Talakona forest is one of the deciduous forests present in the Eastern Ghats in Chittoor district, Andhra Pradesh, India. It is a deep forest with herbs, shrubs, and valleys. Talakona forest depends on monsoons for rainfall. There are two rivers which are across the forest: Penna and Swarnamukhi rivers. This forest is surrounded by Seshachalam hills and Balapalli forest. It is one of the biospheres as well as hotspots of India, which has high fauna and flora of different and rare species. The species of the flora of the forest include *Terminalia pallid*, *Cycas beddomei*, *Boswellia ovalifoliolata*, and *Shorea tambaggia* (Bubesh Gupta et al., 2014).

The geographical area of the forest is 79°8′E of longitude and 13°43′N of latitude and 667 M of altitude. The forest temperature is max 43˚C and min 25˚C in the summer and max 31˚C and min 16˚C in the winter season. The annual rainfall of the forest is 800–1000 mm (Priya et al., 2011). Mallikarjuna Rao et al. (2017) studied the phenology and pollination mechanism of *V. albicans*.

Pharmacognostic studies and phytochemical screenings of *V. albicans* plant leaf extracts have shown the presence of various phytochemical constituents such as flavonoids, alkaloids, saponins, aromatics, alcohols, alkanes, carboxylic acids, steroids, tannins, tannins, amino acids, proteins, carbohydrates, glycosides, and biological properties. For instance, the leaves and roots of the plant have been used for the treatment of diseases like stomach infections, fever, kidney problems, and hiccups. The leaves are used as a flavor for soups due to its bitter nature;

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it has also been used as a laxative, for diarrhea, as a fertility inducer, for cough and hepatitis. The platyhelminthis and nematodal worms have been cured by the leaf extract (Egharevba et al., 2014).

The plant extracts possess inhibition of lipid oxidation as well as protection of enzymes and vitamins (Alara et al., 2017).

During primary metabolic process, oxidative stress in human beings will generated which requires antioxidants. The antioxidant can be estimated from the plant extracts by the experiments such as ethanol and DPPH system (2,2, diphenyl-1-picrylhydrazyl) decoloration (Adeolu adedapo et al., 2007). As per studies, Antimicrobial activity have done by three methods, they were phenol extract, ethyl alcohol extract and distilled water extract. The ethyl alcohol extract has more antimicrobial activity than distilled water extract and phenol fraction (extract). he antioxidant activity was done by ethanol and aqueos extract. The ethanol has more reduction than aqueos extract. The flavonoids such as luteolin-7-o-β-glucoside, luteolin-7-o-β-glucuronoside and luteolin have antioxidant activity and antimicrobial activity. The saponins and steroids such as verno-amyosides, which were further classified as A, B, C and D, also posses the antioxidant activity. The sesquiterpene also responsible for antioxidant activity, which include hydroxyvernolide, vernodalin, vernodalol, vernolide and vernodalinol (Nursuhaili et al., 2019).

Considering the above, the present work aims to screen the bioactive compounds present in the *V. albicance* plant leaf extracts and study their antimicrobial, antioxidant, and phytochemical properties and their usage as an antimicrobial compound for pathogenic microorganisms.

Methods

Collection and Identification of Plant

The selected plant in the present study has collected from the forest of Talakona, Chittoor district, Andhra Pradesh, India. The plant was provisionally identified and confirmed as Vernonia albicance DC, with the help of the flora (Madhavachetty et al., 2009).

Extraction of Secondary Metabolites

The plant material was collected and the leaves were separated, shade dried for 2 weeks, and powdered with the mortar and pestle. One gram of leaf powder was soaked in 10 mL of ethyl alcohol and water separately, and the mixture was heated in the water bath till it was reduced to 5 mL. The extract was filtered, and the filtrate was stored in glass vials at a low temperature in the refrigerator for the present investigation and for further scientific studies.

Estimation of Phenol Compounds

Estimation of phenols was performed by mixing 25 µL of alcohol extract with 75 µL of ethanol and then with 200 µL of Folin–Ciocalteu reagent; the reaction mixture was incubated for 15–20 min in a dark place. After incubation, the solution was mixed with 500 µL of water and 200 µL of sodium bicarbonate (20%) and then made up to 1 mL. After incubation, the appearance of blue color was an indication of the presence of phenolic compounds and was considered a positive result. After that, the readings were taken using a calorimeter at 720 nm with blanks, and controls were maintained. The gallic acid used was as a standard for the comparison and calibrated for the estimation of total phenolic compounds in the extracts, and the phenols were represented as equivalents of gallic acid (Hagerman et al., 2021).

Estimation of Total Antioxidant Activity

Antioxidant estimation was studied by the method of Preito et al. (2021). According to this method, 4 mM ammonium molybdate was mixed with 28 mM sodium phosphate. This solution was mixed with .6 mM sulfuric acid. Later, 100 µL of plant extract was mixed with 1 mL of ammonium molybdate and kept for incubation at 90°C for 90 min. After incubation, the formation of the end color (blue) was measured in a spectrophotometer at 695 nm. The formation of blue color indicates the positive result for the presence of the antioxidant property of the plant extract (Prieto et al., 1999).

2,2,Diphenyl-1-picrylhydrazyl Scavenging Activity

The DPPH (2,2,diphenyl-1-picrylhydrazyl) solution was prepared in methanol as .004% solution and is used for measuring the scavenging activity. The extracts of various concentrations were mixed with 1 mL of DPPH solution and incubated in a dark place for 15 min. The disappearance was taken as the scavenging effect of the tested samples. The range of the discoloration in the test samples of different concentrations and the standard (ascorbic acid) was measured after incubation. The end product was measured in a spectrophotometer at 540 nm. Ascorbic acid was used as a standard and positive control, and the results were discussed (Donata-Bandoniene, 2014).

Antimicrobial Activity

The antibacterial activity of plant extracts was studied by the disc diffusion method. For this, the bacterial cultures such as *Escherichia coli* (MTCC 1133), *Pseudomonas aeruginosa* (MTCC 7296), *Klebsiella pneumonia* (MTCC 7028) (Gram negative), and *Staphylococcus aureus* MTCC 7443 (Gram positive) were obtained from the Institute of Microbial Technology. Cultures were grown on fresh sterilized Mueller–Hinton agar media. In each culture plate, 20 mL of media was transferred to sterilize glass Petri plates and allowed for solidification. After solidification, the bacterial cultures were inoculated and left for growth for 24 hours; these cultures were utilized for antimicrobial activity. The media was prepared and distinguished into two parts: one part of the media was mixed with an antibiotic (amoxicillin) as a positive control and the other part of the media without antibiotic as a negative control. The Whatman No.1 filter paper was taken and cut into 6 circular pieces. The media was prepared and poured into the autoclave Petri plates; then after solidification, the bacterial cultures which were grown were inoculated on the Petri plates. The sterile glass rod was taken and spread in the media (Padma & Venkat Raju, 2013). The three petri plates were taken one for phenol fraction, one for ethyl alcohol extraction and one for distilled water extraction. The filter paper discs were dipped in the phenol fraction, ethyl alcohol extract and distilled water extract separately. The phenol fraction was taken as positive control and ethyl alcohol extract and distilled water extract was taken as negative control. The discs were dried for few minutes and placed on the pre-inoculated petri plate's separately for the phenol fraction, ethyl alcohol extract and distilled water extract and left for 24 hrs at 37°C in the incubator. After 24 hrs the zone was formed it indicates the antimicrobial activity, i.e., zone of inhibition. The zone was measured by the metric scale (Bauer et al., 1964).

Results

Determination of Total Phenolics in Plant Extracts

The present investigation revealed the total phenols in the ethyl alcohol/water extract as 50.6 and 82.1 mg/mL for 1 gram of dry leaf powder, respectively, and was expressed as equivalents of gallic acid standard.

The phenols are more important natural secondary metabolites that possess immense importance in the pharmaceutical industries for the preparation of medicines (Jain et al., 2014). A few phenols were reported from the medicinal plants, namely phloroglucinol acid, acetylsalicylic acid, gallic acid, ellagic acid, benzoic acid, vanillin, tannic acid, resorcinol, quercetin, and catechol which exhibit immune-modulatory, anti-inflammatory, and antipyretic properties (Mrdu, 2012). The flavonoids, thymol, quercetin, eugenol, menthoside, vitamin K, and isorhoifolin also exhibit antimicrobial and antiallergic properties. The other secondary metabolites include monoterpenes (limonene, menthone, methyl acetate cineole, and menthofuran), sesquiterpenes and triterpenes, sitosterol, squalene, and ursolic acid (Biswas et al., 2014).

The production of reactive oxygen species which cause oxidative stress is decreased by the flavonoids, for instance, quercetin and mandelic acid which are isolated from *Aesculus Indica*. The other flavonoids gliricidia and quercetin-7-O-rutinoside were isolated from *Asplenium nidusnidus* L, which is a fern that shows antimicrobial activity. The microorganism *Propionibacterium acnes* was inhibited by the flavonoid kaempferol, which is present in *Impatiens balsamina* L. They minimize breast cancer. Furthermore, the arresting of cell division of cell lines was reported by flavonoids (Mothana et al., 2009), for example, quercetin-7-O-rutino side and gliricidia-O-hexoside, which are isolated from *A. Nidus* medicinal plant. The other flavonoids were reported to cure cardiovascular disease, namely phenylpyruvic acid-2-O-β-D-glucoside and aspalathin present in *Aspalathus linearis*. The anti-inflammatory properties are reported by flavonoids, namely apigenin, luteolin, quercetin, and hesperidin, which are isolated from *Lonicera caerulea* L (Tungmunnithum et al., 2018).

Antioxidant Activity

The antioxidant activity was estimated by the appearance of blue color as a positive result using ammonium molybdate. The antioxidants from *V. albicans* of ethanol and aqueous extracts were 50.5 and 80.4 mg/mL from one dry leaf powder, respectively, which is similar to the standard (ascorbic acid). Free radicals are unpaired electrons, which originate from the metabolism. If the free radicals are more, it leads to several diseases like cardiovascular disease, diabetes, and cancer. Free radicals should be neutralized by the antioxidant, and then diseases will not occur (Kumar & Singh, 2014).

2,2,Diphenyl-1-picrylhydrazyl Scavenging Activity

The graph (Figure 1), shows the concentration of secondary metabolites as well as the percentage of inhibition. Firstly, 10 µg/mL of ascorbic acid of .04 concentration showed 30% of inhibition, 20 µg/mL of .06 concentration showed 55% of inhibition, 40 µg/mL of .08 concentration showed 78% of inhibition, 50 µg/mL and 60 µg/mL of .010 and0.012 concentrations showed 95% and 105% of inhibition, respectively. The ethanol extract of 15 µg/mL of concentration of .04 showed 18% of inhibition, 30 µg/mL of .06 concentration showed 35% of inhibition, 40 µg/mL of 0.08 concentration showed 50% of inhibition, followed by 50 µg/mL and 60 µg/mL of .010 and .012 concentrations showed 70% and 90% of inhibition, respectively. The water extract of 15 µg/mL of 1.12 concentration showed 5% of inhibition, 30 µg/mL of 1.14 concentration showed 23% of inhibition, 45 µg/mL of 1.16 concentration showed 43% of inhibition, and 55 µg/mL of 1.18 and 60 µg/mL 1.20 of concentrations showed 65% and 87% of inhibition, respectively. The water extract of 15 µg/mL of 1.12 concentration showed 5% of inhibition, 35 µg/mL of 1.14 concentration showed 23% of inhibition, 43 µg/mL 1.16 concentration showed 43% of inhibition, 55 µg/mL of concentration showed 63% of inhibition, and 70 µg/mL of concentration showed 85% of inhibition. Ethanol extract showed higher concentration of inhibition than water extract (Figure 1). The phenol fraction of 15 µg/ml of 1.12 concentration showed 5% of inhibition, 35 µg/ml of 1.14 concentration showed 23% of inhibition, 43 µg/ml 1.16 concentration showed 43% of inhibition, 55 µg/ml of concentration showed 63% of inhibition and 70 µg/ml of concentration showed 85% of inhibition. Ethanol extract showed higher concentration inhibition than water extract (Figure 1).

Antimicrobial Activity

The graph (figure 2) shows the antimicrobial activity of phenol fraction of *V. albicans* leaves at high concentration of phenol in *P. aeruginosa* than other bacteria. *K. pneumonia* has less phenol concentration than other bacteria.

The *V. albicans* leaves extracts were tested against Gram-positive and Gram-negative bacterial strains with a phenolic fraction of extract. The Muellen–Hinton agar media and glassware were autoclaved, and after autoclaving, the glassware and media were kept in the laminar airflow. The media was mixed with the antibiotic (amoxicillin), and the antibiotic mixed very well was taken as control. After that, up to 20 mL

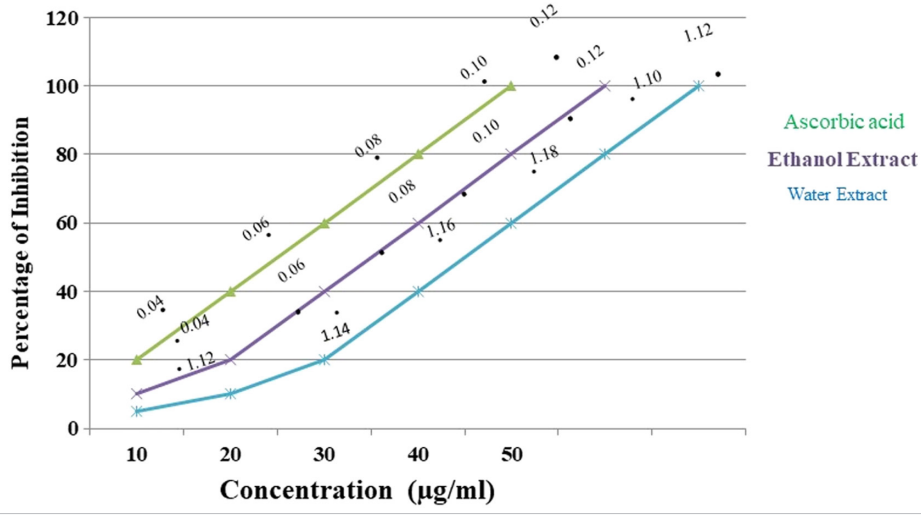

Figure 1.
DPPH Scavenging Activity of Leaf Extracts. DPPH, 2,2,diphenyl-1-picrylhydrazyl.

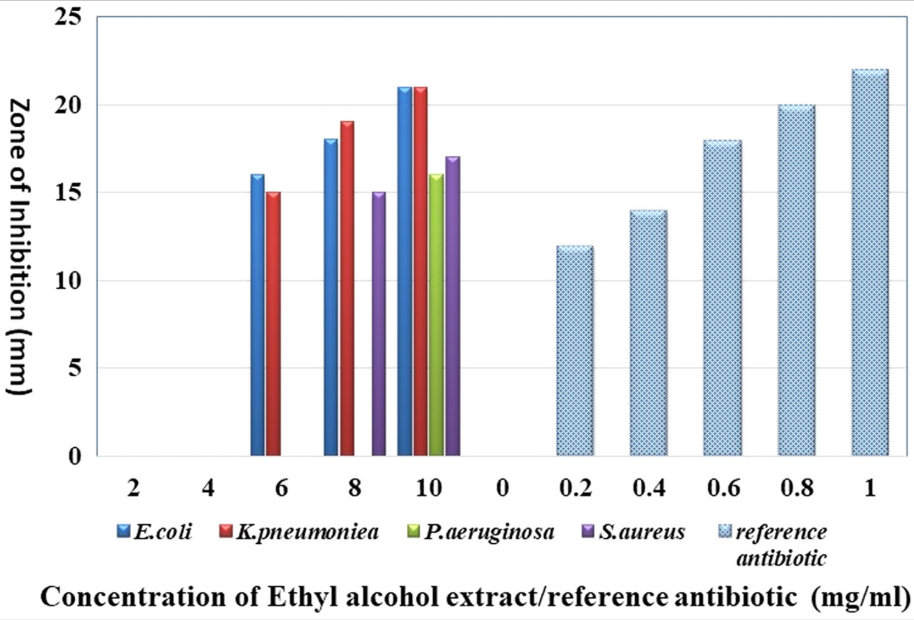

Figure 2.
The Graph of Antimicrobial Activity of Ethyl Alcohol of Vernonia albicans Leaves.

of the media was poured into the autoclave Petri plates; the plates were left to solidify, and after solidification, the bacterial cultures were poured into the media. The autoclaved glass rod was taken to spread the culture throughout the Petri plates. The cultures used were *E. coli*, *K. pneumoniae*, *P. aeruginosa*, and *S. aureus.* The Whatman No 1 filter paper was cut as a circular piece and dipped in the phenol; the dipped papers were kept on the media. The different concentrations used were 2 mg/mL, 4 mg/mL, 6 mg/mL, 8 mg/mL, and 10 mg/mL (Figure 2).

The Petri plates were kept in the incubator for 24 hours at 37°C. After 24 hours, the antimicrobial activity was observed by the formation of clear zones, whereas in the wells of concentrations of 2 mg/mL, 4 mg/mL, and 6 mg/mL, no inhibition zones were observed. The 8 mg/mL *K. pneumonia* well had 15 mm of zone, *P. aeruginosa* had 15 mm of zone, same antimicrobial activity as *K. pneumonia*, and *S. aureus* had 19 mm of zone, which had more antimicrobial activity than other bacterial strains. The extracts with 10 mg/mL *E. coli* had 17 mm of zone formation, *K. pneumoniae* had 20 mm of zone, *P. aeruginosa* had 22 mm of zone formation, and the antimicrobial activity decreased in *S. aureus* showing only 20 mm of zone formation. The concentration increases proportionality zone of inhibition increases (Table 1; Figure 2).

The bacteria showed higher amount of ethyl alcohol in 10 mg/mL, when compared to other concentration.

The *V. albicans* leaves extracts were tested against both Gram-positive and Gram-negative bacteria with ethyl alcohol. The Mueller–Hinton agar media and glassware were autoclaved. The autoclaved media and glassware were kept in the laminar air flow. The antibiotic (amoxicillin) was mixed in the media and shook very well to dissolve. The media was poured in the Petri plates and left for solidification; after solidification, the bacterial culture was poured on the media. The sterile glass rod was used to spread throughout the Petri plates. The cultures used were *E. coli*, *K. pneumoniae*, *P. aeruginosa*, and *S. aureus*. The Whatman No. 1 filter paper was cut in ae circular form and dipped in the ethyl alcohol. The different concentrations used were 2 mg/mL, 4 mg/mL, 6 mg/mL, 8 mg/mL, and 10 mg/mL. The Petri plates were kept in the incubator for 24 hours at 37°C. The Petri plates were observed after 24 hours, and the antimicrobial activity was estimated by the formation of the zone. At lower concentration (2 mg/mL and 4 mg/mL), very less or no inhibition (antimicrobial activity) was observed (Figure 3).

In the present study, the plant extract showed a significant antimicrobial activity at various concentrations against bacterial strains. For instance, for the extract of 6 mg/mL, that is, *E. coli* had 16 mm of zone, and *K. pneumonia* had 15 mm of zone. The other two bacterial strains did not show any antimicrobial activity. The bacterial culture of *E. coli* showed good antibacterial property with 18 mm of zone, whereas *K. pneumonia* showed 21 mm zone of inhibition. Similarly *S. aureus*

Table 1.
Antimicrobial Activity of Phenol Fraction of Vernonia albicans Leaves

Microorganisms	2 (mg/mL) (Con)	4 (mg/mL)	6 (mg/mL)	8 (mg/mL)	10 (mg/mL)	Standard Antibiotic
Escherichia coli	-	-	-	-	17	21
K. pneumoniae	-	-	-	15	20	17
P. aeruginosa	-	-	-	15	22	16
S. aureus	-	-	-	19	20	17

Note: Zone of inhibition represented in mm diameter for mean values of three replicates.

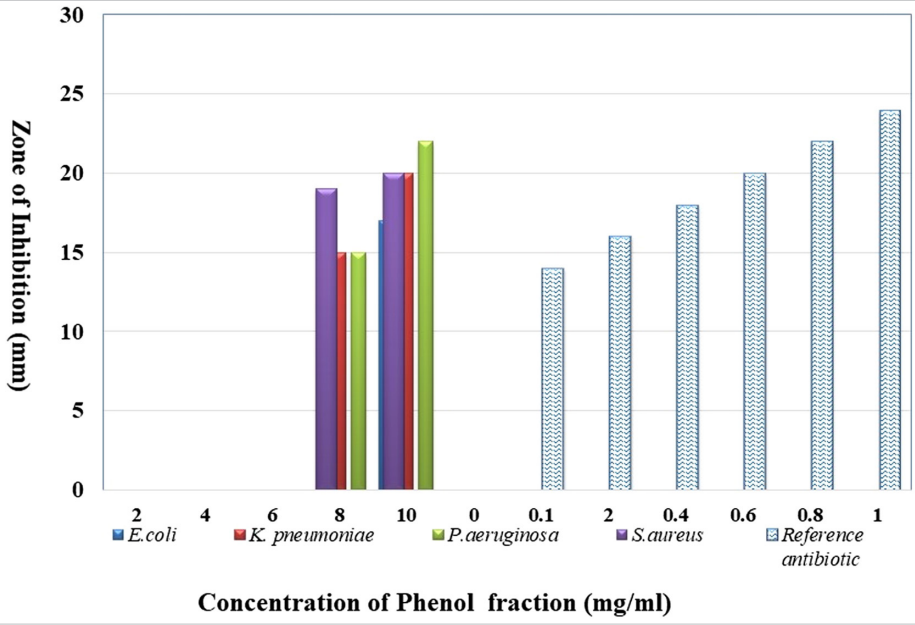

Figure 3.
The Graph of Antimicrobial Activity of Phenol Fraction of Vernonia albicans Leaves.

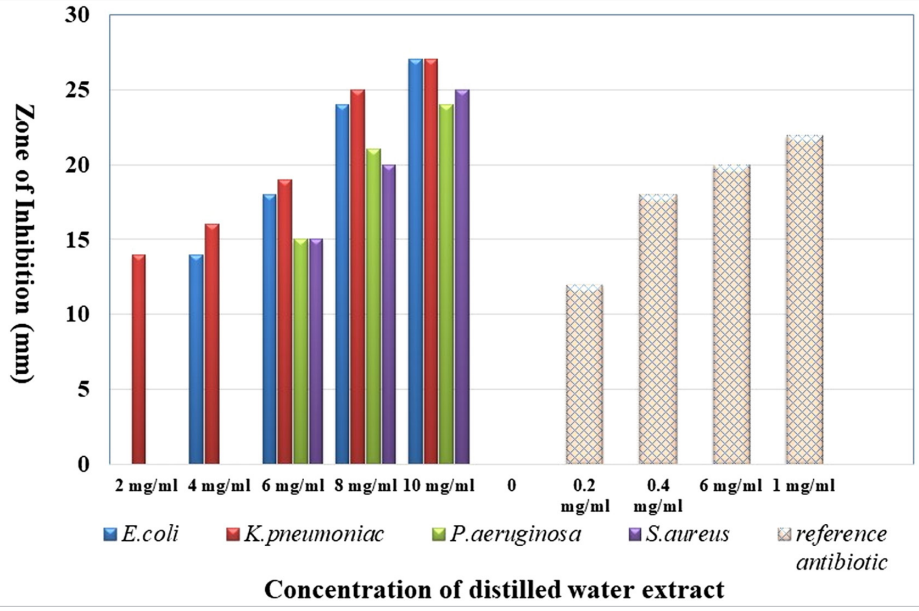

Figure 4.
The Graph of Antimicrobial Activity of Distilled Water of Vernonia albicans Leaves.

Table 2.
Antimicrobial Activity of Ethyl Alcohol Extract of Vernonia albicance Leaves

Microorganisms	2 (mg/mL) (Con)	4 (mg/mL)	6 (mg/mL)	8 (mg/mL)	10 (mg/mL)	Reference Antibiotic
Escherichia coli	-	-	16	18	21	15
Klebsiella pneumoniae	-	-	15	19	21	24
Pseudomonas aeruginosa	-	-	-	-	16	18
Staphylococcus aureus	-	-	-	15	17	19

Note: Zone of inhibition represented in mm diameter for mean values of three replicates.

Table 3.
Antimicrobial Activity of Distilled Water Extract of Vernonia albicance Leaves (mg/mL)

Microorganisms	2 (mg/mL)	4 (mg/mL)	6 (mg/mL)	8 (mg/mL)	10 (mg/mL)	Reference Antibiotic
Escherichia coli	-	14	18	24	27	16
Klebsiella pneumoniae	14	16	19	25	27	15
Pseudomonas aeruginosa	-	-	15	21	24	24
Staphylococcus aureus	-	-	15	20	25	17

Note: Zone of inhibition represented in mm diameter for mean values of three replicates.

showed inhibition zone with 15 mm. In contrast. *P. aeruginosa* did not show any antimicrobial activity For the extract of 10 mg/mL, *E. coli* showed antimicrobial activity by a 21-mm zone formation. The bacterial strain *K. pneumonia* exhibited 21-mm inhibition zone, whereas *P. aeruginosa* showed very less antimicrobial activities by forming 16 mm of zone than *S. aureus*. *S. aureus* showed 17 mm of zone formation. The concentration increased the zone proportionally (Table 3).

The graph (Figure 4) showed the high concentration in distilled water of 10 mg/mL, the less concentration in 2 mg/mL.

The *V. albicans* leaves extracts were tested against Gram-positive and Gram-negative bacteria. The plant leave extracts with (five) different concentrations were used, for example, 2–10 mg/mL ranges. In this study, the bacterial strain, *K. pneumonia* showed 14 mm of zone formation in the 2 mg/mL concentrayion, whereas *E. coli* showed 14 mm and *K. pneumonia* showed 16 mm of zone in the 4 mg/mL concentration, and other strains did not have any antimicrobial activity. In this study, plant extract at 6 mg/mL concentration inhibited *K. pneumonia* with the formation of 19 mm of zone. The bacterial culture of *K. pneumonia* had more antimicrobial activity, that is, 24 mm of zone was observed in 8 mg/mL than other bacteria, followed by *E. coli* which had 24 mm zone formation, *P. aeruginosa* of 21 mm of zone formation, and *S. aureus* of 20 mm. In the plant extract at 10 mg/mL concentration, two strains showed same antimicrobial activity; *E. coli* and *K. pneumonia* had 27 mm of zone formation, *P. aeruginosa* had 24 mm of zone formation, which showed less antimicrobial property than *S. aureus* with 25 mm of zone. With increasing plant extract concentration, the bacterial inhibitions also increased (Table 3).

In contrast, the results of antimicrobial activity and antioxidant were reported from *Pilea Microphylla* against three bacterial strains, which has highest zone of inhibition, namely, methicillin-resistant *S. aureus*, *Micrococcus* sp., and *Bacillus spizizenii* ATCC6633. The antioxidant properties reported were similar to gallic acid, that is, 9.91 + .33 to .71 mg (Chahardehi et al., 2010). The other strain of antimicrobial activity was reported from the plant *Mauritia Flexuosa* against three bacterial strains, that is, *E. coli*, *P. aeruginosa*, and *S. aureus*, which showed highest zone of inhibition equivalent to *V. albicans* (Hector Koolen et al., 2013).

Discussion

Antioxidants naturally occur in plants, for example, carotenoids, ascorbate, etc., and they neutralize the free radicals which are generated in the metabolism as a by-product. By neutralizing these free radicals, the disease will be cured, for instance, ginkgo, schizandra, licorice, ginger, and quercetin are the plant products having more antioxidants which cure the diseases like blood clot which leads to heart attack, cardiovascular diseases, etc. (Alok et al., 2014).

The antimicrobial activity was tested on Gram-positive and Gram-negative bacterial strains like *E. coli*, *K. pneumoniae*, *S. typhi*, *S. aureus*, and *P. aeruginosa*. The *E. coli* (Gram negative) causes diarrhea, fever, and abdominal pain. The *E. coli* was tested with *V. albicans* leaves extract and showed good antimicrobial activity (James Kaper et al., 2004). Similarly, *K. pneumoniae* (Gram negative) is the causative agent of liver abscess. The antibacterial activity of *V. albicans* leaves clearly showed minimum inhibitory zone. By the result, the plant may be used as a drug for *K. pneumonia* (Fung et al., 2002). *S. aureus* (Gram positive) is a bacterium. The symptoms of the bacterial infection are bacteremia, osteomyelitis, pneumonia, endocarditis, wound infections, and skin infection. The bacteria cause disease by the release of the *Staphylococcal* enterotoxin (Jarraud et al., 2002). Similarly, *S. aureus* was tested with *V. albicans* leaves. It clearly showed the inhibitory zone. *P. aeruginosa* (Gram negative) is a bacterium that causes chronic obstructive pulmonary disease (Timothy Murphy et al., 2008). The bacterium was tested with *V. albicans* leaves; it clearly showed the inhibition, that is, minimum inhibitory concentration.

In contrast, there are so many reports of antimicrobial activity on bacterial strains, within the *Vernonia* species. Due to the presence of secondary metabolites, which show antioxidant and antimicrobial activity, for instance, saponins, tannins, flavonoids, and alkaloids, which are reported from root and stem of *Vernonia amygdalina* (Johnson et al., 2015), it shows antimicrobial activity against bacterial strains such as *P. aeruginosa*, *S. aureus*, Aspergillus *niger*, and *C. albicans* (Audulnusa, 2018). Moreover, it has been reported that the leaves of *V. amygdalina* show antimicrobial activity on chronic skin ulcers as well as on other bacterial strains, that is, *K. pneumonia* and *Proteus mirabilis* (Mboto et al., 2009). Eye infection, fever, and antipyretic were cured by the leaves of *Vitis cinerea* (Varsha, 2016). Similarly, it has been showed that urinary tract infections were cured by *V. amygdalina* against *Proteus and E. coli* (Uzoigwe & Agwa, 2011).

Furthermore, reports showed the antimicrobial activity on fungal species, for instance, dandruff was cured by *V. cinerea* leaves (Dhanalakshmi et al., 2013). The antifungal activity of *Veronia lasiopus* strain was reported that is, *C. albicans* (Rachuonyo et al., 2016). The other strain *Veronia schimperi* has antimicrobial activity on *C. albicans* and *E. coli* due to the presence of secondary metabolites, for instance, phenols, flavonoids, tannins, and alkaloids (Rajasekaran, 2017).

Similarly, the reports show that the antimicrobial activity of Gram-positive and Gram-negative bacteria is due to the presence of phytochemicals. The two fungal pathogens were reported, that is, the leaf spot disease of sweet potato caused by *Cercosporella* and the leaf spot disease of *Brazilian ginseng* caused by the strain *Cercosporella faffiae* (Ilondu, 2013). Furthermore, the antioxidant and antimicrobial activity of different strains in *Vernonia* species are as follows: the antioxidant

activity of *V. amygdalina* is .03 mg/mL, which is less than *V. albicans* (Erastoet al., 2007). The antioxidant activity of *V. cinerea* is 100 mg/mL, which is more than *V. albicans* (Sonibare et al., 2016). The antimicrobial activity of *V. cinerea* on Gram-positive and Gram-negative bacteria of the inhibitory zone is 10 mm and 12 mm, respectively. The inhibitory zone is less than that of *V cinerea* (Mubo et al., 2016). The inhibitory zone of 14 mm of Gram positive and 11 mm of Gram negative are reported for *V. amygdalina* (Evbuomwan et al., 2018). The inhibitory zone of *V. colorata* is 5 mm of Gram-positive and 10 mm of Gram-negative bacteria (Rabe et al., 2002). Rajendran et al., (2018) reported that the *V. schimperi* extracts exhibited anti bacterial activity against both gram positive and gram negative bacteria. The antimicrobial activity of different strains were less than that of V. albicans (Ogundare et al., 2005). Similar studies reported antibacterial effects of Vernonia amydgalina (Rajasekaran et al., 2017), *Ziziphus jujuba* Mill (Seku et al., 2020, 2021), *Frankincense gum* (Seku et al., 2022), *Aerva lanata* leaf (Palithya et al., 2020), *Pterocarpus santalinus* leaf (Vaishnavi et al., 2020) extracts and silver nanoparticles.

Ethnobotany Merits and Conclusion

The forest is nature's gift to humans. There are different flora and fauna in the forest. There are varieties of plants. Some of them are medicinal plants, some are useful for cosmetics, some are used as dyes, and some of them are useful for furniture, etc. It has been proved that medicinal plants are used to treat several diseases. Few plants such as *Ruellia brittoniana* L are used for cardiovascular screening. It has been reported that the eye disease gastroenteritis, bleeding from wounds, and skin diseases were cured by the plant *Dicliptera roxburghiana* Nees (Shinwari et al., 2017).

In this study, the in vitro antioxidant, antimicrobial, and phytochemical activities of *V. albicans* plant leaf extracts from Talakona forest in Chittoor District, Andhra Pradesh, India, were studied. The secondary metabolites (phenol) of the *V. albicans* plant extract showed good antioxidant activity. The plant leaf extract has potential antimicrobial activity against both Gram-positive and Gram-negative bacterial strains. Results from this study promise the production of cost-effective eco-friendly antimicrobial compounds from *V. albicance* plant leaf extracts and their usage as phytomedicine for the treatment of various bacterial diseases.

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