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Research Article

Phytochemical Investigation and Antimicrobial Activity Study of Ornamental Plant *Caladium x hortulanum*

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ABSTRACT
Medicinal plants play a major role in all the traditional system of medicine and contain the richest source of plant metabolites. They are used for human welfare, especially to cure disease caused by pathogenic microorganisms without any side effects. This present study was carried out to determine the phytochemical components and antimicrobial activity of *Caladium x hortulanum* plant pars such as leaf, stem and corm. In this investigation, the leaf extracts contained more numbers of phytochemical constituents and possess good antimicrobial activity against pathogenic microorganisms such as *Escherichia coli, Klebsiella pneumoniae, Staphylococcus aureus, Bacillus cereus, Aspergillus fumigatus, Aspergillus niger* and *Penicillium chrysogenum*. These results indicate the ornamental plant *Caladium x hortulanum* have antimicrobial values that could be useful in the treatment microbial diseases.

Keywords: Medicinal plants, phytochemicals, *Caladium* and antimicrobial activity.

INTRODUCTION

Microbial infection is a common health problem in many countries. Peoples of rural areas used different plant parts for the ailment of various bacterial infections. The medicinal plants continue to play an important role in the management of different microbial diseases[1]. Plant materials remain important resources to combat serious diseases of the world. Pharmogonostic investigations of plants are borne out to find novel drugs or templates for the growth of novel therapeutic agents[2]. Complete 60% of the world human population, 80% in developing countries depending directly on plants for their medicinal uses. Even the great unwashed from the western societies show increased interest and preference for drugs from medicinal plants[3]. Medicinal values of many plants still remain unexplored in its enumerable activity of compounds responsible for later. Nevertheless, plant materials remain important resources to combat dangerous diseases of the macrocosm. Phytochemicals may protect human from a host of diseases. They are non-nutritive plant chemicals that have protective or disease preventive properties. The plant produces these chemicals to protect itself, but recent research demonstrates that many phytochemicals can protect humans against diseases. There are many phytochemicals in fruits and herbs and each works differently[4]. The plant develops a broad diversity of secondary metabolites which are employed either directly as precursors or as lead compounds in the pharmaceutical industry and it is expected that plant extracts showing target sites other than those used with antibiotics will be active against drug resistant microbial pathogens[5]. The increasing interest on traditional ethnic medicine may lead to discovery of novel therapeutic agents. Medicinal plants are getting their way into pharmaceuticals, neutralceuticals, cosmetics and food supplements. In the present work, an effort has been made to enrich the knowledge of phytochemical constituents and antimicrobial activity of ornamental plant *Caladium x hortulanum*.

MATERIALS AND METHODS

Plant sample

Plant sample of *Caladium x hortulanum* was collected from Kanyakumari District, Tamil Nadu. The collected material was rinsed severally with clean tap water to make it dust and debris free and subjected to drying in a dark place at room temperature for a few days (up to the sample get shade dry). Different plant parts such as leaf, stem and corm were ground in electric chopper to get a fine powder form for further use.

Preparation of extracts

The plant powder was subjected to soxhlet extraction using different solvents such as aqueous, acetone, dimethyl sulfoxide, chloroform and ethanol. Each 5 g of dried, powder of plant material was filled separately in the thimble and extracted successively with 60 ml of solvents using a soxhlet extractor for 3 h. After solvent evaporation, each of these solvent extract was weighed and preserved at room temperature until further use.

Phytochemical tests

Phytochemical component screening tests were performed for all the extracts in the presence of chemical constituents.

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Table 1: Phytochemical careening of *Caladium x hortulanum*.

S. No.	Chemical Constituents	Leaf					Stem					Corm				
		AQ	DM	AC	CH	ET	AQ	DM	AC	CH	ET	AQ	DM	AC	CH	ET
1.	Carbohydrates	+	-	+	+	+	-	-	-	-	-	+	-	+	+	+
2.	Protein	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
3.	Amino acid	-	-	+	-	-	-	-	+	-	-	-	-	+	-	-
4.	Vitamin C	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
5.	Chloride	+	-	-	-	+	+	+	-	-	-	+	-	-	-	+
6.	Tannins	-	-	+	+	+	-	-	-	-	-	+	-	+	+	+
7.	Alkaloids	+	-	-	-	-	+	-	-	-	-	-	-	-	-	-
8.	Flavonoids	+	+	+	-	-	+	+	+	+	-	-	+	+	-	-
9.	Phlobatannins	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
10.	Steroids	+	+	-	+	-	+	+	+	+	+	-	+	-	+	-
11.	Phenols	-	-	-	-	+	-	-	-	-	-	+	-	-	-	+
12.	Saponins	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

AQ=Aqueous; DM=dimethyl sulfoxide; AC=acetone; CH=chloroform; ET=ethanol

Table 2: Antimicrobial activities of *Caladium x hortulanum*.

S. No.	Test organisms	Leaf					Stem					Corm				
		AQ	DM	AC	CH	ET	AQ	DM	AC	CH	ET	AQ	DM	AC	CH	ET
1.	*E.coli*	-	-	11	10	10	10	-	12	10	11	10	-	14	10	11
2.	*K.pneumoniae*	11	11	10	-	-	10	11	11	11	10	10	11	11	11	10
3.	*S.aureus*	-	10	12	16	20	-	10	10	12	11	-	10	-	12	11
4.	*B.cereus*	-	10	-	11	12	-	10	10	10	12	-	10	22	10	12
5.	*A.fumigatus*	-	14	10	12	15	-	11	10	10	10	-	-	10	10	13
6.	*A.niger*	-	10	12	12	12	-	10	10	11	11	-	10	19	11	11
7.	*P.chrysogenum*	-	14	12	-	10	-	10	-	10	11	-	10	-	10	11

AQ=Aqueous; DM=dimethyl sulfoxide; AC=acetone; CH=chloroform; ET=ethanol
Zone of inhibition values are in 'mm'

The major components such as carbohydrate, protein, amino acid, vitamin-C, chloride, tannin, alkaloids, flavonoids, phlobatannin, steroids, phenols and saponin were screened according to the common phytochemical methods described by Harborne[6].

Antimicrobial activity

Antimicrobial activities of different extracts were determined by the well diffusion method against 4 bacterial and 3 fungal pathogens *viz*. *Escherichia coli, Klebsiella pneumonia, Bacillus subtilis, Staphyloccocus aureus, Aspergilus niger, Aspergillus fumigatus* and *Penicillium chrysogenum*. Pure cultures of the above human pathogenic microorganisms were obtained from Kamini Biotech, Thuckalay, Kanyakumari District. The test bacterial strains were inoculated into Nutrient Broth medium and incubated at 37℃ for 24 h. Fungal strains were inoculated into Potato Dextrose Broth medium and incubated at 28° C for 48 h. After the incubation period, the culture tubes were compared with the turbidity standard. Antimicrobial activity was carried out by agar well diffusion method. Fresh bacterial cultures of 0.1 ml having 108 colony forming unit were spread onto Nutrient Agar plate using sterile cotton swab, likewise the fungal cultures were spread onto Potato Dextrose Agar plate. The wells were punched off into agar medium with sterile well puncture. Each well filled with 50 µl of each plant extract by using a micro pipette in a septic condition. The plates were then kept in a refrigerator to allow pre-diffusion of the extract for 30 min and further incubated at 37℃ for 24 h and 28℃ for 48 h for bacterial and fungal plates respectively. The results were observed by measuring the zone of inhibition.

Gas chromatography-Mass spectrophotometry

Further the best sample was analysed by Gas chromatography-Mass spectrophotometry (GCMS). The column (HP5) was fused silica 50 m x 0.25 mm I.D. Analysis conditions were 20 min. At 100℃, 3 min at 235℃ for column temperature, 240℃ for injector temperature, helium was the carrier gas and split ratio was 5:4. The sample (1 µl) was evaporated in a split less injector at 300℃. Run time was 22 min. The components were identified by gas chromatography coupled with mass spectrometry.

RESULTS

Phytochemical tests

The leaf extract of *Caladium x hortulanum* contained carbohydrate, amino acid, chloride, tannins, alkaloids, flavonoids, steroids and phenols; stem extract contained amino acid, chloride, tannins, flavonoids, steroids and phenols; and the corm extract contained carbohydrate,

Table 3: Phytochemical components of *Caladium x hortulanum* (L).

Peak No.	Run Time	Area %	Compound name
1.	3.835	3.13	2-Butanone, 4-hydroxy-3-methyl
2.	4.715	3.62	Azulene
3.	7.568	38.02	Xanthosine
4.	9.792	4.35	3-deoxy-d-mannoic lactone
5.	14.084	20.82	1-ascorbic acid 2,6-dihexadecanoate
6.	14.555	7.11	hexadecanoic acid, ethyl ester
7.	16.460	9.42	9,12-octadecanoic acid (Z,Z)
8.	16.543	9.47	E,E,Z-1,3,12-nanodecatriene-5,14-diol
9.	16.896	4.06	ethyl(9Z,12Z)-9,12-octadecanoic acid

amino acid, chloride, tannins, flavonoids, steroids and phenols (Table 1).

Antimicrobial activity

Antimicrobial activities of the samples were evaluated by a zone of inhibition (mm). Solvent extracts from all three plant parts were exhibited inhibitory activity against entire tested organisms such as *E. coli, K.pneumoniae, S.aureus, B.cereus, A.fumigatus, A.niger* and *P.chrysogenum* (Table 2).

Gas chromatography-Mass spectrophotometry

GCMS analysis of the leaf showed 9 peaks between the rum times of 3.835 to 16.896 min. The phytochemical compound found in the plant sample was 2-Butanone, 4-hydroxy-3-methyl; azulene; xanthosine; 3-deoxy-d-mannoic lactone; 1-ascorbic acid 2,6-dihexadecanoate; hexadecanoic acid, ethyl ester; 9,12-octadecanoic acid (Z, Z); E, E,Z-1,3,12-nanodecatriene-5,14-diol; ethyl(9Z,12Z)-9,12-octadecanoic acid (Table 3).

DISCUSSION

Qualitative phytochemical analysis of the plant extracts was performed by standard protocols. In this present study, the plant extract of *Caladium x hortulanum* contained the phytochemical constituents such as carbohydrate, amino acid, chloride, tannins, alkaloids, flavonoids, phenols, steroids. Also it was observed that, the leaf extracts contained more phytochemical constituents than the stem and corm extracts. Further, a total of nine phytochemical components were identified from the leaf extract by GCMS analysis. Among the identified compounds, xanthosine and 1-ascorbic acid 2, 6-dihexadecanoate were found as higher volume. In the antimicrobial activity test, all the plant materials exhibited inhibition activity against all the tested organisms includes *E. coli, K. pneumoniae, S. aureus, B. cereus, A. fumigatus, A. niger* and *P. chrysogenum*. The zone of inhibition was varied with different solvents used, among the five solvents used chloroform and ethanol extracts showed good antimicrobial activity also the leaf extracts were established good inhibitions on the microorganisms. These may the presence of phytochemical constituents in the plant materials. The phytochemical constituents such as alkaloids, flavonoids, tannins, phenols, saponins, and various other aromatic compounds are secondary metabolites of plants that serve a defence mechanism against prediction by many microorganisms, worms and other herbivores[7,8]. Flavonoids are hydroxylated phenolic substance known to be synthesized by plants in response to microbial infection[9]. Steroids have been described to have antibacterial properties, the correlation between membrane lipids and sensitivity for steroidal compound indicates the mechanism in which steroids specifically associate with membrane lipid and exerts its action by causing leakages from liposomes[10]. Tannins bind to proline rich proteins and interfere with the protein synthesis[11]. Biswas *et al*.[12] reported the antimicrobial activity of *C. bicolor* against several antimicrobial strains and the most susceptible one was *Staphylococcus aureus*. Essien *et al*.[13] has studied the antimicrobial activity of *C. bicolor* and *C. tricolor*. The different concentrations of leaves and bulbs extracts exhibited reasonable antibacterial and antifungal activity against selected wound pathogens such as *Streptococcus pyogenes, Pseudomona aeruginosa, Klebsiella pneumoniae* and *Candida albican*s.

CONCLUSION

The present study reveals the continuation of antimicrobial components in the medicinal plant *Caladium x hortulanum.* The study about antimicrobial activity of *C. hortulanum* is limited and these results helpful for further investigation of *C. hortulanum* plants to assess their chemical prospective in future research.

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