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Antibacterial Activity of Floral Petals of Some Angiosperms

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Authors' contributions

This work was carried out in collaboration among all authors. Author LR designed the study, performed the statistical analysis, wrote the protocol and wrote the first draft of the manuscript. Authors NSK and NSS managed the analyses of the study. Author SL managed the literature searches. All authors read and approved the final manuscript.

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ABSTRACT

The *in vitro* antibacterial assay was carried out against both Gram positive (*B. cerus* and *S. aureus*) and Gram negative (*E. coli* and *K. pneumoniae*) bacteria. Floral petals of 20 different species of plants were collected and tested for antibacterial activity. The result showed that the petals were active against both Gram positive and Gram negative. Out of 20 floral petals tested, 19 floral petals exhibited antibacterial activity against selected bacterial strains. The minimal inhibitory zone of floral petal discs against human pathogenic bacteria varies from 2 – 6 mm. *Rosa carolina* and *Ruellia tuberosa* showed significance inhibition zone for all the bacterial strains while *Lantana camara* does not show inhibition zone for any of these pathogenic bacteria.

Keywords: Floral petals; antibacterial; gram positive; inhibition zone.

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1. INTRODUCTION

Plants have been used as an exemplary source of medicine worldwide in treatment and prevention of various diseases. Plants also provide natural source of antimicrobial drugs which may be employed against some infectious diseases. Medicinal plants research has increased all over the world. With the advent of antibiotics there has been tremendous increase in the resistance of diverse bacterial pathogens. This shift in the susceptibility greatly affects the ability to treat the patients. Multiple drug resistance to the various commercial available antimicrobial drugs and certain adverse effects caused by them on host like hypersensitivity, immune-suppression and allergic reactions are few serious problems to be considered.

Secondary metabolites produced by the plants constitute a source of bioactive substance. Plants have almost limitless ability to synthesize them. In many cases, these substances serve as plant defence mechanism against microorganisms, insects and herbivores. Useful antimicrobial phytochemicals can be categorized as phenolics, terpenoids, alkaloids, lectins and polyacetylenes. These are synthesized and deposited in specific parts or in all parts of the plant. The plants secondary products may exert their action by resembling endogenous metabolites, ligands, hormones, signal transduction molecules or neurotransmitters and thus have beneficial medicinal effects on humans due to similarities in their potential target sites. Therefore, random screening of plants for active chemicals are as important as the screening of ethno botanically targeted species.

Flowers have served as an excellent offering to god, an invaluable aid for personal makeup and a source of inspiration to poets. Since the beginning of civilization, man has been accustomed to use flowers to make his festivals more festive. For plants, flowers are the structures of sexual reproduction.

Since the time immemorial flowers are used to decorate the idols of god. Before decoration, they were bathed to purify with various types of media viz., honey, tender coconut, milk, curd, butter, ghee, sugar and ultimately with water. These are prone to growth of various microorganisms such as bacteria, fungi, viruses and other microbes. But the microbial growth has not been pronounced due to the decoration with flowers. This made us to work on this direction during the present study.

Information on antimicrobial activity of plant flowers and especially petals were scanty. The petal tissues may possess antimicrobial activity [1]. Interestingly, the symptoms of most plant diseases of bacterial and fungal origin have been reported mostly on the leaves, stem and roots seldom on petals [2]. In recent years, plant extracts are used to test the antimicrobial activity. Hence in the present investigation, a few selected floral petals of angiosperms were screened to test their potential antibacterial activity.

2. MATERIALS AND METHODS

2.1 Collection of Plant Materials

Floral petals of the selected plants were collected from in and around Jnanabharathi campus, Bangalore University, Bangalore. The petals were first surface sterilised with 0.01% $HgCl_2$ for 10 sec and washed with sterile distilled water for 3 successive times. The sterilized petals were punched by using sterilized puncture to obtain petal discs.

2.2 Preparation of Nutrient Agar

28 g of nutrient agar powder was dissolved in 1ltr of distilled water and the mixture was heated to dissolve the contents completely and autoclaved at 121ºC for 15min. Later the contents were poured into sterilised petriplates for solidification.

2.3 Preparation of Inoculum

The human pathogenic bacteria viz., *Bacillus. cerus* (MTCC 121), *Escherichia coli* (MTCC 7410), *Staphylococcus aureus* (MTCC 7433) and *Klebsiella pneumoniae* (MTCC 7407) were obtained from MTCC (Microbial type culture collection), IMTECH, Chandigarh, India. All the test bacteria were maintained on nutrient agar (NA) medium and periodic subculture was carried out.

The inoculum was prepared according to procedures of CLSI (Clinical and laboratory standards Institute, 2002). Using spread plate method, the test bacteria were cultured on Meuller-Hinton Agar (Himedia laboratory pvt. Ltd., India) and incubated for 18 - 24 hrs at 37°C. The colonies were suspended in 5ml of Mueller-Hinton agar broth. The density of the bacterial culture required for the test adjusted to 0.5

McFarland standard, (1.0X10^8 CFu/ml) (Schwable et al., 2007).

2.4 Disc Diffusion Method

Disc diffusion method was performed according to CLSI M44-A document. 20 different sterilized floral petal discs of 5 mm diameter was placed on the surface of the medium acting as negative control and standard antibiotic (amphicillin) served as positive control. The plates were incubated at 37°±2 for 24 hrs and next day the inhibition zone was recorded. Each test was done in three replicates and the results were tabulated.

3. RESULTS

During the present investigation, 20 different floral petals of angiosperms were randomly selected depending on their fragrance, colour and size are belonging to 13 different families such as Apocynaceae, Asteraceae, Bignoniaceae, Acanthaceae, Brassicaceae, Ceasalpinaceae, Rosaceae, Oleaceae, Papilionaceae, Malvaceae, Moringaceae, Verbenaceae and Lythraceae totalling of about 20 genera and 20 species.

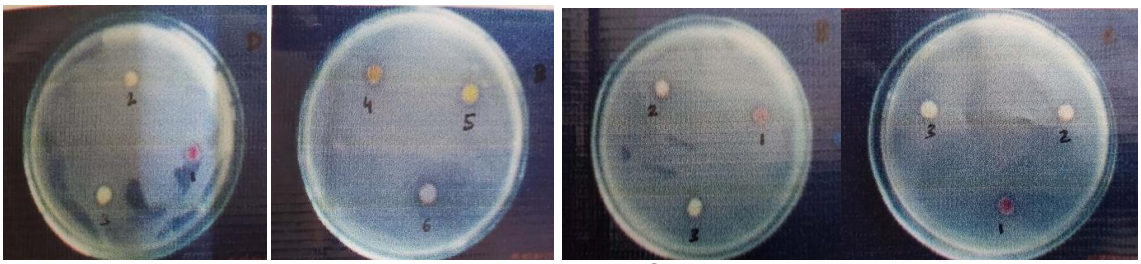
The antibacterial activity of the floral petals of 20 different plants were tested against both gram positive (*B. cerus* and *S. aureus*) and gram negative (*E. coli* and *K. pneumoniae*) (Fig. 1) bacterial strains and the results shown in Table 1. Out of 20 floral petals tested, 19 floral petals exhibited antibacterial activity against bacterial strains. The present investigation clearly revealed that *Rosa carolina* and *Ruellia tuberosa* showed significance inhibition zone (6 mm) for *B. cerus, S. aureus, E. coli* and *K. pneumoniae,* while *Lantana camara* does not show inhibition zone for any of these pathogenic bacteria. The minimal inhibitory zone of floral petal discs against human pathogenic bacteria varies from 2 – 6 mm.

4. DISCUSSION

Information on antimicrobial activity of plant flowers and especially petals were scanty. The petal tissues may possess antimicrobial activity [1]. The present study demonstrates the antibacterial activity of 20 different floral petals. This is one of the first studies evaluating the effect of floral petal discs directly on human pathogenic bacteria. The rapidity of this screening procedure by direct testing to identify the petals of specific plant species as a source of new antibiotics and drugs.

According to the studies of Darokar et al., (1998), the petals of 26 out of 110 varieties of rose showed detectable antibacterial activities against more than 5 gram positive and 6 gram negative bacterial strains. In the present investigation, out of 20 floral petals, 19 were showing detectable antibacterial activity against 2 gram positive and 2 gram negative bacteria using spread plate method. Antonelli et al*.,* [3] reported that the extraction of floral petals of different types are used to cure diarrhoea and enlarged tonsils. Further Hirulkar et al., [4] reported that the petroleum ether and alcoholic extracts showed the antimicrobial activity against the pathogenic bacteria. Similarly, the plant floral extracts of *Plumeria alba* appears to have significant antimicrobial capacity.

Devayani Bahl et al., (2016) worked on the determination of antibacterial and antifungal properties of rose extracts found to exhibit an appreciable antifungal and antibacterial property could be due to presence of several phytochemical concentration like alkaloids, flavonoids, glycosides, tannins, saponins, steroids, anthroquinone, phenols, resins, fatty acids and gums. As the floral petals are rich in phytoconstituents the authors are in complete agreement with the work of Devayani Bahl et al.



E. coli ***B. cerus*** ***S. aureus*** ***K. pneumoniae***

Fig. 1. Antibacterial activity of floral discs of 1*. Rosa carolina*, 2. *Ruellia tuberosa*, 3. *Moringa oleifera*, 4. *Chrysanthemum indicum*, 5. *Delonix regia* and 6. *Lagerstroemia speciosa*

Table 1. Antibacterial activity of selected angiosperm flowers

Sl. no.	Name	*E. coli*	*B. cerus*	*S. aureus*	*K. pneumoniae*
01.	*Plumeria alba* L.	+	-	-	+
02.	*Chrysanthemum indicum* L.	-	+	+	+
03.	*Tabebuia argentea* (Bureau & K. schum) Britton	-	-	-	+
04.	*Ruellia tuberosa* L.	+	+	+	+
05.	*Brassica nigra* L.	-	+	-	+
06.	*Caesalpinia pulcherrima* (L.) SW	-	-	+	-
07.	*Rosa carolina* L.	+	+	+	+
08.	*Bauhinia variegata* (L.) Benth.	-	+	+	-
09.	*Jasminum trifoliatum* (Lam.) Pers.	-	-	-	+
10.	*Senna auriculata* (L.) Roxb.	-	-	+	-
11.	*Butea monosperma* (Lam.) Taub.	+	-	-	+
12.	*Hibiscus rosa sinensis* L.	+	-	-	-
13.	*Moringa oleifera* Lam.	+	-	+	+
14.	*Lantana camara* L.	-	-	-	-
15.	*Nerium oleander* L.	-	+	+	-
16.	*Wrightia tinctoria* (Roxb.) R.Br.	-	-	+	+
17.	*Lagerstroemia speciosa (*L.) pers.	-	+	+	-
18.	*Nyctanthes arbor-tritis* L.	-	-	-	+
19.	*Delonix regia* (Boj. ex Hook) Raf.	-	+	+	-
20.	*Alstonia scholaris* (L.) R.Br.	-	+	-	-

+ Indicates the presence of antibacterial activity; -Indicates absence of inhibition zone

Syam Sree et al. [5] screened antimicrobial activity of flower extracts on various human bacterial pathogens and compared with the microbial activity of ampicillin. Out of eight floral extracts of plant species that are tested against various microbes, *Magnolia champaca, Michelia alba, Artabotrys hexapetalus, Couroupita guianensis* and *Cananga odorata* gave distinct and different values. Floral extracts of *Magnolia champaca* and *Cananga odorata* are found to be more effective when compared to ampicillin. During the present study, the petal discs of *Rosa carolina* and *Ruellia tuberosa* were found to be effective with reference to amphicillin.

According to Murugananthan et al*.,* (2015) isolated ethyl acetate fractions of *Cucumis maxima* flower extract exhibited a significant antibacterial activity against *S. typhi, E. coli, E. faecalis* and *B. cerus*. The disc diffusion method result showed the different zone of inhibition for varied concentrations against the tested bacteria which is similar to the present investigation. Kambar et al., [6] reported that the methanolic extract of flower of *Q. indica* exhibited antibacterial activity against clinical isolates of *S. aureus* with inhibition zone of 1.5 – 2.3 cm against tetracyclin.

5. CONCLUSION

The results showed that floral petals of many Angiosperm plant species contain antibiotic substances. *Rosa carolina* and *Ruellia tuberosa* showed significance inhibition zone for *B. cerus, S. aureus, E. coli, k.pnemoniae* while *Lantana camara* does not show inhibition zone for any of these pathogenic bacteria. This confirms the therapeutics potency of this flower used in traditional medicine. These results form a good basis for selection of candidate plant species for further phytochemical and pharmacological investigation. This slowly opens up the area for further detailed characterizations of higher plants, using a wide spectrum of biological screen including plant as well as animal pathogenic bacteria. Evaluation of natural products to access new, safe and effective principles to rotate or substitute with the invalidated ones is one of the scientific strategies to combat drug-resistant pathogens.

CONSENT AND ETHICAL APPROVAL

It is not applicable.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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