Evaluation of antibacterial properties of *Musa paradisiaca L.* Leaves

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Abstract

The antibacterial activity of plants have been screened because of their great medicinal relevance with the recent years, infections have increased to a great extent and resistant against antibiotics, becomes an ever increasing therapeutic problem. *Musa paradisiaca* L. cv. Puttabale is very common plant known as banana plant belonging to Musaceae family. Traditionally leaves of banana plant are used to serve food. Aim of present study is to evaluate *Musa paradisiaca L.* (banana) leaves for antibacterial study. Solvents like petroleum ether, chloroform, ethanol are used to prepare leaf extract of *Musa paradisiaca L.* with the help of Soxhlet apparatus. Antibacterial activity of leaf extract was screened against four different bacterial strains *Bacillus subtilis* (NCTC8236), *Escherichia coli* (ATCC25922), *Pseudomonas aeruginosa* (ATCC27853) and *Staphylococcus aureus* (NCTC25953) by agar diffusion method and compared with standard drug Ciprofloxacin a well-known broad-spectrum antibacterial agent. The ethanol extracts of *Musa paradisiaca* showed the broad spectrum of antibacterial activity on the tested microorganisms with high inhibitory potency against *Escherichia coli* and *Staphylococcus aureus.*

INTRODUCTION

From ancient time medicinal plants are more studied because of their benefits to society indeed to mankind, especially in the line of medicine. These natural compounds formed the foundation of modern prescription drug as we know today (Chopra and Nayar 1986). Infectious diseases are the world's leading cause of premature deaths, killing almost 50 000 people every day. In recent years, drug resistance to human pathogenic bacteria has been commonly reported from all over the world (Mulligen *et al*.,1993; Robin *et al*., 1998). Now a days multiple drug resistance has been developed due to the indiscriminate use of commercial antimicrobial drugs commonly used in the treatment of infectious diseases.

In addition to this problem, antibiotics are sometime associated with adverse effects on the host including hypersensitivity, immuno suppression and allergic reactions. This problem forced scientists to search for new antimicrobial substances (Syed *et al* 2011). Therefore, it is a need to develop alternative antimicrobial drugs for the treatment of infectious diseases from medicinal plants (Agarwal *et al.*, 1996). Antimicrobial of plants origin have enormous therapeutic potential. They are effective in the treatment of infectious diseases while simultaneously mitigating many of the side effects that are often associated with synthetic antimicrobials (Manandhar, 1987; Joshi and Edington 1990).

Musa paradisiaca L. is very common plant commonly known as banana plant belonging to Musaceae family. Banana is one of the most popular fruits distributed all over the world. The production of this fruit in India is very high (Venkatesh *et al*.,2013). Traditionally, the fruit, Stem juice, flowers of banana plants were used for treating diarrhoea (unripe), dysentery, menorrhagia, diabetes (Yusuf *et al*., 2009), antilithic (Khare, 2007), antioxidant actions (Krishnan, 2005) and inflammation, pain & snakebite (Coe and Anderson, 1999). Pharmacological investigations revealed that banana fruits, Stem juice, flowers are screened for antidiarrhoeal activity (Rabbani *et al*., 2001), Hypoglycemic activity (Singh *et al*., 2007); Hypocholesterolaemic activity (Vijayakumar *et al*.,2008), antioxidant activity (Yin *et al*., 2008), Diuretic activity (Jain *et al*., 2007), Wound healing activity (Agarwal *et al*. 2009), Anti-allergic activity (Tewtrakul *et al*., 2008), Antimalarial activity (Kaou *et al*., 2008), Literature reviews indicated that banana fruits and flowers contain antibacterial principles. Traditionally leaves of banana plant are used to serve food. Present study aims is to evaluate *Musa paradisiaca L.* (banana) leaves for antibacterial study. Screening of banana leaves against multi-drug resistant, pathogenic organisms.

MATERIAL AND METHODS

Preparation of crude extracts

The leaves of *Musa paradisiaca* cv. Puttabale were collected from the Devrukh, dist Ratnagiri, Maharashtra. The leaves were cleaned with deionized water and dried in oven at 60ºC, grinded in mixer to make fine powder. Dry leaf powder of was continuously refluxed with petroleum ether at 60ºC for 72 hours using Soxhlet apparatus. The solvent extract was then stored in air-tight containers at 4ºC till further use. The same residue was used to prepare chloroform and ethanol extract with help of Soxhlet apparatus. All the above extracts were stored at 4ºC till further use.

Preparation of Standard Bacterial Suspension:

Various culture of human pathogenic bacteria such as *Bacillus subtilis* (NCTC8236), *Escherichia coli* (ATCC25922), *Pseudomonas aeruginosa* (ATCC27853) and *Staphylococcus aureus* (NCTC25953) were obtained from Indira Institute of Pharmacy, Sadawali. The average number of viable, organism per mL of the stock suspension was determined by means of the surface viable counting technique. About (108-109) colony forming units per mL was used. A fresh stock suspension was prepared each time (Hanna *et al*.,2008; Lee *et al*.,2003).

Agar well diffusion assay

Antibacterial activity of leaf extract was screened against four different bacterial strains by agar diffusion method. The culture plates were prepared with sterile nutrient agar media. 100 µl of bacterial culture was inoculated on to the culture plate using sterile L-shaped glass rod to get uniform distribution of bacteria. Wells were created using a stainless steel sterilized cork borer (6.0 mm) under aseptic conditions. 50µl of the plant extracts were aseptically loaded into wells. For comparative evaluation, Ciprofloxacin (BioChemika, ≥98.0% (HPLC) (Fluka)) was used as a positive reference standard and sterile distilled water as negative control. Then, the cultured plates were incubated for 24 h at 37 ºC. After incubation the diameter of the results and growth inhibition zones were measured, averaged and mean values were calculated in mm (Hanna *et al*.,2008; Lee *et al*.,2003).

RESULTS AND DISCUSSIONS

The Antibacterial efficacy of different solvent extracts of *Musa* leaves is shwn in Table 1. The *Musa* leaf extract prepared in chloroform shows antibacterial activity against *Bacillus subtilis* , *Escherichia coli* and other bacteria also. The *Musa* leaf extract prepared in ethanol shows antibacterial activity against *Staphylococcus aureus, Escherichia coli* mainly and other bacteria also. In case of *Bacillus subtilis, Musa* leaf extract prepared in chloroform showed better antibacterial activity when compared to extract prepared in ethanol (Fig.1). Same pattern was exhibited by *Escherichia coli* (Fig.2). When antibacterial activity of *Musa* leaf extract was studied in case of *Pseudomonas aeruginosa* (Fig.3) and *Staphylococcus aureus* (Fig.4), chloroform showed better results than ethanol extract. The antibacterial activity of various extract of leaves of *Musa paradisiaca* showed varying magnitudes of inhibition patterns with standard drug Ciprofloxacin a well-known broad-spectrum antibacterial agent.

The extracts of *Musa paradisiaca* leaves prepared in Petroleum ether does not show any inhibition area. The chloroform extracts of *Musa paradisiaca* leaves showed inhibition zone upto 17 mm for different strains of bacteria. When compared with standard i.e. Ciprofloxacin *Musa paradisiaca* leaves extracts were found more effective against *Staphylococcus aureus.* Ahmad and Beg (2001) investigated the alcoholic extracts of *Musa paradisiaca* banana fruit peel showed better activity against the *Staphylococcus* (Gram-positive) and *Pseudomonas* (Gram-negative) than banana leaf extract. However, the alcoholic stem extract showed no activity against *Staphylococcus aureus, Salmonella paratyphi, Shigella dysenteriae, Escherichia coli, Bacillus subtilis, Candida albicans* (Venkatesh *et al*.,2013). Similar results are reported by Fagbemi *et al.*, 2009 with ethanolic and aqueous extract of unripe Musa. Ethyl acetate extract of *Musa. sapientum* seeded banana peel and pulp exhibited significant higher antibacterial activity than the ethanolic extract (Jain, *et al*., 2011). The results obtained in this study showed less antibacterial activity than earlier results and may be it depends on the cultivar of banana and geographical distribution. The differences in the antibacterial activities of the various extracts may be due to varying degree of solubility of the active constituents in the solvents used. The difference in potency may be due to the stage of collection of the plant sample, different sensitivity of the test strains and method of extraction (Nimri *et al*., 1999). Plant extracts and phytochemical are becoming popular as potential sources of antibacterial and several reviews have been written (Rojas *et al*., 1992). Since the *Musa* leaf extract appear to have a broad antibacterial activity spectrum, it could be useful in antiseptic and disinfectant formulations as well as in chemotherapy.

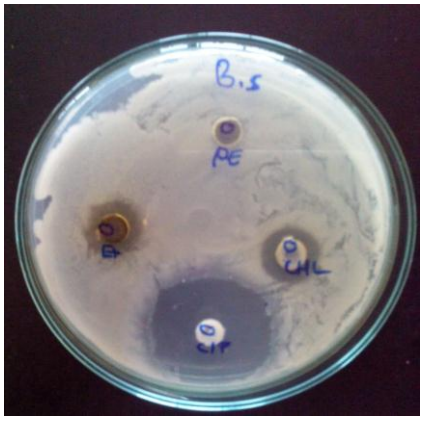

Fig. 1 Antimicrobial activity of the Banana extracts on *Bacillus subtilis*

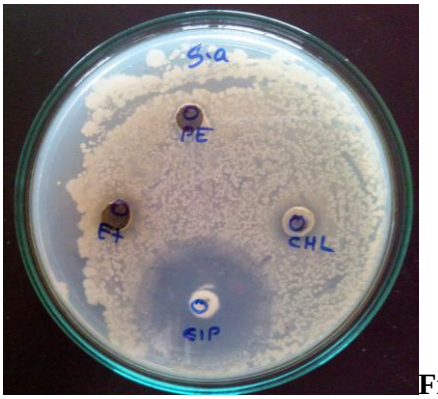

Fig.2 Antimicrobial activity of the Banana extracts on *Staphylococcus aureus*

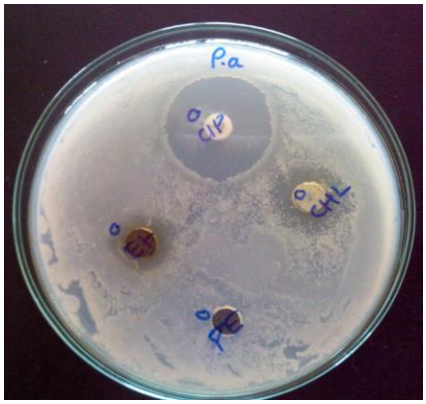

Fig.3 Antimicrobial activity of the Banana extracts on *Pseudomonas aeruginosa*

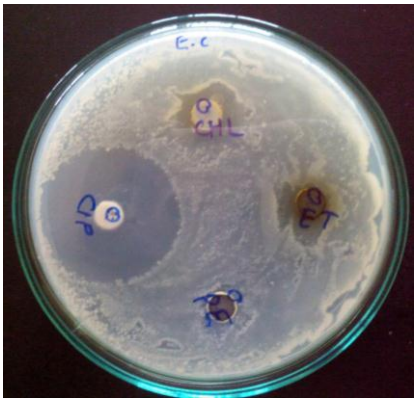

Fig.4 Antimicrobial activity of the Banana extracts on *Escherichia coli*

Table 1. Antibacterial efficacy of different solvent extracts of *Musa* leaves

Bacteria	Strain	Zone of inhibition (mm)			
		Petroleum Ether	Chloroform	Ethanol	Standard *(Ciprofloxacin)*
Bacillus subtilis	+ ve	0	15	14	32
Escherichia coli	- ve	0	17	14	35
Pseudomonas aeruginosa	- ve	0	12	11	30
Staphylococcus aureus	+ ve	0	17	12	26

The optimal effectiveness of a medicinal plant may not be due to one main active constituent, but to the combined action of different compounds originally in the plant (Gonzalez *et al*., 1994).

Conclusion

Musa paradisiaca (banana leaves) exhibited antibacterial properties. The ethanol extracts of *Musa paradisiaca* cv. Puttabale extracts showed the broad spectrum of antibacterial activity on the tested microorganisms with high inhibitory potency against *Escherichia coli* and *Staphylococcus aureus.* For the extraction of *Musa paradisiaca* chloroform is more suitable while petroleum ether is least recommended. The extract of *Musa paradisiaca* leaves prepared in chloroform showed good antimicrobial activity.

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