

Antimicrobial efficacy of fresh and dried banana peel extracts: An *in vitro* study

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ABSTRACT

Background: Banana is one of the valuable sources for maintaining human health. The use of fresh banana peel extracts for antimicrobial properties can be of great significance in therapeutic treatments. **Objective:** This study aimed to evaluate the antibacterial activity of both fresh and dried various banana peel extracts. **Materials and Methods:** Alcoholic extract of banana peel extracts was subjected to antibacterial efficacy against Gram-positive and Gram-negative bacteria by the well agar diffusion method. **Results:** The alcoholic extract of fresh and dried banana peel showed a various inhibitory effect against various microbial isolates. Highest inhibitory effects were observed on Nendran and Poovan against *Staphylococcus aureus* (13.55 ± 0.04), *Bacillus subtilis* (13.26 ± 0.02), and *Pseudomonas aeruginosa* (14.5 ± 0.00). **Conclusion:** Alcoholic peel extracts of fresh and dried banana could be considered as a good antibacterial agent against both Gram-positive and Gram-negative bacteria.

KEY WORDS: Alcoholic banana peel extract, Banana, Gram-positive and Gram-negative bacteria, Well agar diffusion

INTRODUCTION

Nowadays, screening of alternate effective and safe medicine from potential medicinal plants is led by the increasing antibiotic-resistant microbial infectious agent. The phytometabolites have great potential to inhibit bacteria, fungi, and virus. Various parts of the plant such as bulb, gel, leaves, roots, barks, and peels were used for the extraction of phytometabolites.^[1] The current practice of medicine today has changed a lot from its practice in medieval times. However, in India, we still use traditional practice for the treatment of various diseases since the Vedic period.^[2]

Banana, one of the tropical fruits belonging to Musaceae family, is grown in many regions of all over the world.^[3] All parts of the banana plant such as flower, pulp, stem, and leaves have a medicinal application.^[4] The flowers in bronchitis and dysentery and on ulcers; cooked flowers are given to diabetics; the astringent plant sap in cases of hysteria, epilepsy, leprosy, fevers,

hemorrhages, acute dysentery, and diarrhea, and it is applied to hemorrhoids, insect and other stings, and bites; young leaves are placed as poultices on burns and other skin afflictions; the astringent ashes of the unripe peel and of the leaves are taken in dysentery and diarrhea and used for treating malignant ulcers;^[5] the roots are administered in digestive disorders, dysentery, and other ailments; banana seed mucilage is given in cases of diarrhea in India.^[6]

The previous studies have shown that waste material of banana peel has medicinal properties.^[4,7] Various bioactive compounds such as flavonoids, tannins, phlobatannins, alkaloids, glycosides, and terpenoids are present in banana peel which exerts a pharmacological effect, especially as an antioxidant, antidiabetic, anti-inflammatory, and antibiotic.^[7] Phytocompounds extracted from various parts of the banana plant in which exhibited significant inhibitory effect toward the foodborne pathogens; hence, banana plant should be considered to be a potential natural source of antimicrobial as well as antioxidant agent.^[8] Therefore, the present study was aimed to evaluate the antimicrobial activity of fresh and dried banana peel extracts against clinical pathogens as a comparative study.

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MATERIALS AND METHODS

Bacterial Culture

The bacterial culture *Staphylococcus aureus*, *Bacillus subtilis*, *Pseudomonas aeruginosa*, and *Escherichia coli* were obtained from Microbiological Laboratory of Kovai Medical Center and Hospital, Coimbatore, and the antibacterial assay was carried out in the Department of Microbiology, Dr. N.G.P. Arts and Science College, Coimbatore, Tamil Nadu, India.

Sample Collection

The various varieties of the banana peels used for the investigation were obtained from the farmers in and around Coimbatore. 50% of each peel was directly used for extraction and remaining 50% peel was air-dried and ground into powder with a mechanical blender. The powdered samples were stored in clean brown bottles at room temperature for further use.

Extract Preparation

Fresh banana peels were coarsely chopped and dried banana peels powder were kept in 70% ethyl alcohol. Then, the entire mixture was homogenized in blender and left at room temperature for about 48 h. As the reaction continued, the yellow transparent liquid turned to amber and later to an opaque black liquid that served as the indicator for completion of the reaction. After completion of the reaction, the entire slurry was filtered through Whatman filter to get banana peel extract.^[9] The filtrate was subjected to rotary vacuum evaporator to get solid solvent free curd extract and stored for further bioassay.

In Vitro Antibacterial Assay

A loopful of bacterial cultures was inoculated into nutrient broth incubated at 37°C for 18 h and checked the purity. The log phase bacterial suspensions were diluted with sterile nutrient broth to adjust the turbidity and compare with standard tube (McFarland number 0.5) to yield a uniform suspension containing 1.5×10^8 CFU/ml. The sterile cotton swab was dib into the standardized bacterial culture to make lawn culture on Mueller-Hinton agar surface of plates and

the plates were left for 5–15 min at room temperature to dry. Sterile cork borer was used to cut well (6 mm diameter) on lawn cultured plates. Solvent-free banana peel extracts were dissolved in dimethyl sulfoxide (DMSO); from this, 0.1 ml was added to the well. DMSO and chloramphenicol were used as negative and positive control, respectively. The plates were incubated at 37°C for 18–24 h and the size of the zone of inhibition was measured. Each experiment was carried out in triplicate.

Determination of Minimum Inhibitory Concentrations (MICs)

The banana peel extracts were subjected into the determination of the MIC using the tube dilution technique.^[10] A two-fold serial dilution was made using Muller-Hinton broth (MHB). The following concentrations were obtained: 1025 mg/ml, 512.5 mg/ml, 256 mg/ml, 128 mg/ml, 64 mg/ml, 32 mg/ml, 16 mg/ml, and 8 mg/ml. Equal volume of extract and MHB (2 ml) was dispensed into sterilized test tubes. A quantity (0.1 ml) of standardized inoculum (1.5×10^8 cfu/ml) was added to each of the test tubes which were incubated aerobically at 37°C for each 24 h. A tube containing broth and inoculum without extract similarly tube with broth and extract without inoculum served as organism control and extract control, respectively. The lowest concentration of the extracts which inhibited microbial growth (no turbidity) was recorded as the MIC.

Statistical Analysis

Each experiment was done in triplicate, and the data were expressed as mean \pm standard error of mean.

RESULTS AND DISCUSSION

A total of eight dried peel extract and eight fresh peels of various varieties of the banana peel extracts were used for the present study. The antibacterial efficacy of both fresh and dried banana peel extracts against clinical isolated was examined and the results were tabulated [Tables 1 and 2]. The fresh peel extract of Nendran showed significant activity against *S. aureus* (13.55 ± 0.04) and *P. aeruginosa* (14.5 ± 0.00) and showed

Table 1: Antibacterial activity of dried banana peel sample

Sample name	Zone of inhibition in mm			
	<i>S. aureus</i>	<i>B. subtilis</i>	<i>P. aeruginosa</i>	<i>E. coli</i>
Rasthali	9.53 \pm 0.47	9.5 \pm 0.04	12.51 \pm 0.02	9.51 \pm 0.2
Nendran	0	9.15 \pm 0.11	10.48 \pm 0.02	9.09 \pm 0.11
Kadali	0	13.5 \pm 0.04	12.26 \pm 0.17	9.09 \pm 0.12
Red banana	0	9.16 \pm 0.12	14.49 \pm 0.00	9.02 \pm 0.02
Karpooravalli	9.51 \pm 0.02	9.4 \pm 0.15	9.5 \pm 0.00	0
Robusta	9.52 \pm 0.02	10.53 \pm 0.2	10.53 \pm 0.04	9.51 \pm 0.01
Poovan	0	11.5 \pm 0.08	11.53 \pm 0.04	10.5 \pm 0.02
Pachai nadan	9.15 \pm 0.12	10.5 \pm 0.08	0	11.49 \pm 0.04
Chloramphenicol	9.03 \pm 0.04	13.02 \pm 0.02	14.49 \pm 0.03	20.0 \pm 0.04

S. aureus: *Staphylococcus aureus*, *B. subtilis*: *Bacillus subtilis*, *P. aeruginosa*: *Pseudomonas aeruginosa*, *E. coli*: *Escherichia coli*

moderate activity against *B. subtilis* (12.5 ± 0.04) and *E. coli* (10.51 ± 0.02), whereas the dried peel extract of Nendran not showed activity against *S. aureus* and showed moderate activity against other organisms. Similarly, fresh peel extract of Poovan showed significant activity than chloramphenicol used as positive control. Whereas, dried Poovan peel extract not showed acceptable activity against clinical pathogens. Other fresh and dried banana (Pachai nadan, Rasthali, Robusta, Kadali, and Karpooravalli) peel extracts showed minimum efficacy against the pathogens.

Effect of plant constituents can combat human and plant pathogenic bacteria, fungi, and viruses without toxic side effects and environmental hazards.^[11] The consumption of banana is good due to its nutritional value. It is used in anemia, stroke^[12] depression, stress, heartburn,^[13] etc. Banana peel which is an outer shell of banana also has been studied for the treatment of mosquito bites,^[14] gastrointestinal disorders,^[15] and nipple fissures caused by *S. aureus*.

The previous study reported the antifungal and antimicrobial properties of yellow banana fruit peel and found that it is effective against different Gram-positive and Gram-negative bacteria.^[16]

In our present study, we focused on various fresh and dried banana peel extract to screen the efficacy on clinical pathogens as a comparative study. In this

study, aerobic Gram-positive and Gram-negative microorganisms were subjected to evaluate the impact of banana peel extracts against infectious agent. The previous studies used either dried or fresh peel extracts only, but in our present study, both extracts were examined their efficacy. This study revealed fresh Nendran banana peel extract significant activity than chloramphenicol which used as positive control. The higher amount of more bioactive compounds was extracted with ethanol 70% due to its higher polarity than pure ethanol. In the present study also, 70% ethanol was used for the extraction of active compounds from the banana peel, it may be the reason for the activity of the Nendran peel extracts which indicate the organic solvents like ethanol one of the extracting solvents to extract the phytochemicals.

The ethanolic fresh banana peel extracts were evaluated MIC ranging from 8 µg/ml to 1025 µg/ml [Figure 1]. The least MIC 128 µg/ml of Nendran and Poovan against *S. aureus* and moderate MIC (256 µg/ml) against *B. subtilis* and *P. aeruginosa* was observed. Other banana peel extracts showed the highest MIC against the clinical pathogens.

Certain studies conclude that banana peel extract not only inhibits the non-spore-forming bacteria but also unidentified substance extracted from banana skin has been shown to inhibit spore formation of bacteria using plate biological assay, the unknown substance

Table 2: Antibacterial activity of fresh banana peel sample

Sample name	Zone of inhibition in mm			
	<i>S. aureus</i>	<i>B. subtilis</i>	<i>P. aeruginosa</i>	<i>E. coli</i>
Karpooravalli	12.23±0.20	10.5±0.04	11.07±0.08	10.51±0.04
Pachai nadan	10.53±0.3	9.17±0.12	0	0
Rasthali	9.55±0.04	9±0.06	13.5±0.04	10.5±0.02
Robusta	0	0	12.47±0.03	10.5±0.00
Nendran	13.55±0.04	12.5±0.04	14.5±0.00	10.51±0.02
Kadali	10.55±0.22	6.1±0.41	11.52±0.03	9.5±0.00
Red banana	12.51±0.01	9±0.03	0	12.0±0.00
Poovan	13.13±0.09	13.26±0.02	0	18.5±0.01
Chloramphenicol	9.03±0.04	13.02±0.02	14.49±0.03	20.0±0.04

Highlighted data indicate the significant activity. *S. aureus*: *Staphylococcus aureus*, *B. subtilis*: *Bacillus subtilis*, *P. aeruginosa*: *Pseudomonas aeruginosa*, *E. coli*: *Escherichia coli*

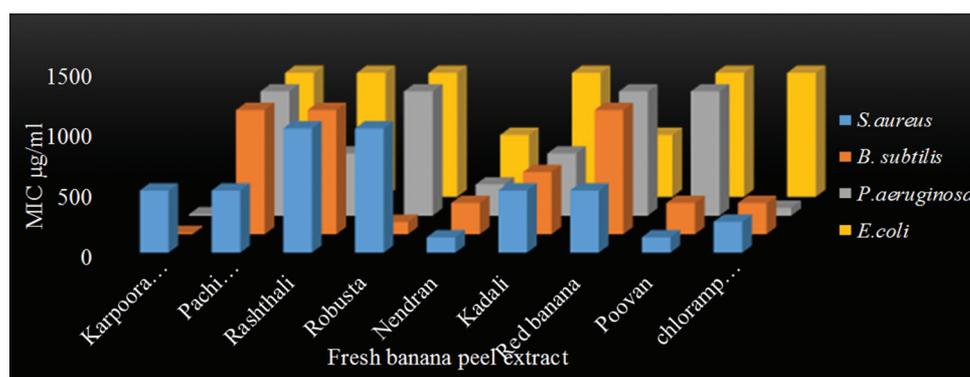


Figure 1: MIC of fresh banana peel extracts against clinical bacterial isolates

demonstrates inhibitory effects at pH values as high as 7.5.^[17] In our present study, the fresh banana peel extract showed optimum level of inhibition against some clinical pathogens.

CONCLUSION

Alcoholic peel extracts of fresh and dried banana could be considered as a good antibacterial agent against both Gram-positive and Gram-negative bacteria to replace the synthetic medicines in the treatment of diseases caused by bacteria.

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