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Antibacterial Potential of *Musa acuminata* against Pathogenic Bacteria

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Abstract

Fruit peels have been shown to be a valuable resource for improving human health. Because fruit peel extracts have antibacterial qualities, using them in therapeutic treatments can be beneficial. The purpose of this study was to evaluate banana peels' antibacterial properties. Using the Kirby-Bauer method, the antibacterial qualities of fresh yellow banana peel aqueous and ethanol extracts were evaluated against pathogenic bacterial isolates, including Salmonella, Shigella, Escherichia coli, Staphylococcus, and Klebsiella species. Different microbiological isolates were inhibited to differing degrees by the fresh banana peel aqueous and ethanolic extracts. Fresh yellow banana peel extracts may be considered powerful antibacterial agents that work against both Gram-positive and Gram-negative bacteria. As such, they could be utilized as a substitute for synthetic drugs in the treatment of illnesses brought on by both pathogens.

Keywords: Banana peel, Urine sample, Antibacterial activity

Introduction

The Musaceae family includes the three genera (Musa, Musella, and Ensete) that make up the herbaceous plant known as the banana (Probojati *et al.*, 2021). Based on the latest data from the Food and Agriculture Organization (FAOSTAT, 2019), India is the world's largest producer of bananas, with 30,460,000 tons produced annually, followed by China and Indonesia. More than 1000 banana varieties, which vary in color, flavor, and chemical makeup, are grown and consumed worldwide, making bananas the most widely accessible and reasonably priced crop. The plantain is called the cooking cultivar, while the banana is called the dessert cultivar (Oyeyinka & Afolayan, 2020; Vu *et al.*, 2018). According to Khoozani *et al.*, (2019), banana plants are cultivated mostly for their fruit and, to a lesser extent, for their natural fibers and wine.

They serve as shade as well, and because of their vast surface area and waxy texture, the tree's leaves are ideal for packing large amounts of food (Ahmadi *et al.*, 2019 resistance to already existing antibiotics. Finding new and potent antimicrobial chemicals has become necessary due to the continuous development of bacterial substances. To the best of our knowledge, the majority of earlier evaluations covered the plant's antioxidant potential in great depth, but very few have addressed its antimicrobial properties or the distinct ways in which various banana extracts combat foodborne bacteria. The antibacterial activity of various banana plant sections, the produced nanoparticles, their bioactive components, and their latest uses in food processing are therefore covered in this study. The outer shell, or cover, of the banana fruit is called the peel. It is a by-product of banana processing and domestic use. It's a meal for animals. Concerns have been raised, nonetheless, regarding how the tannin in the husks may affect the animals who eat them. In addition, banana peels are utilized in the manufacturing of inorganic waste, cooking.

Nutritional value of Banana peel

Goats, Chickens, Fish, Zebra and Many Other Animals Occasionally Utilize Banana Peels as Nourishment. Because peels have less fiber than dessert banana peels and their lignin content rise with ripening (from 7 to 15% dry matter), the nutritional value of banana peels varies depending on the cultivar and maturity stage. Banana peels that have been dried provide 20–30% fiber and 6–9% protein. 40% of the starch in green plantain peels is converted to sugars as they mature. Ripe banana peels include up to 30% free sugars, but green banana peels have only 15% starch, compared to 15% in green plantain peel]. With the use of banana peels in water purification], it is used to make ethanol, cellulase, and laccase (poly copper oxidase) as a fertilizer.

Potential of Banana Peel in Chemical Cosmetics

Banana peel (*Musa sapientum*) has been shown to contain a variety of minerals and nutrients. The banana peel includes 1.95 ± 0.14% crude proteins, 5.93 ± 0.13% crude fat, and 11.82 ± 2.17% carbohydrates. The minerals found in banana peels were calcium, magnesium, sodium, iron, and phosphorus. Very low levels of manganese, copper, potassium, and zinc (mg/100 g) were discovered.

Table 1. Nutritional Component of Banana Peel

S. No	Nutritional Component	Average Content, % DM
1.	Starch	3.5 – 6.3
2.	Resistant Starch	2.3 – 2.5
3.	Dietary Fiber	47 – 53
4.	Crude Fat	2.24 – 11.6
5.	Crude Protein	5.5 – 7.87
6.	Ash	9 – 11
7.	Carbohydrate	59.51 – 76.58

Materials and Methods

Collection of Banana Sample: We bought fresh bananas from the Virudhunagar local market. In the lab, bananas were cleaned using running tap water. Following a 70% alcohol surface sterilization and a sterile distilled water rinse, the bananas' skins were removed.

Extraction: After an hour of boiling distilled water, the peels were added and let to cool. In order to obtain a clear aqueous extract, the contents were further blended and filtered to eliminate the large, irregular particles (Zainab *et al.*, 2013). Until it was time to use it, the extract was stored at 4°C. Fresh banana peels were cut into small pieces and combined with 100 milliliters of ethanol solution in a conical flask to create the ethanolic extract. The flask was then put in a rotary shaker for three days. To get a clear extract, it was filtered after three days to get rid of big particles and contaminants. The antibacterial properties of these extracts were used.

Isolation of microorganisms: At Jana Lab in Virudhunagar, a urine sample was taken from a patient suffering from a UTI in order to separate microorganisms for antibacterial testing. A student at our college had a sample of their wounds taken. Plates of Salmonella Shigella (SS), Mannitol Salt Agar (MSA), and Eosin Methylene Blue (EMB) agar were made. The surfaces of Salmonella Shigella agar, Mannitol Salt Agar, and EMB agar were streaked with a loopful of the urine sample. After that, the plates were incubated for 24 hours at 37°C. Both pink mucoid colonies and colonies with a metallic sheen were visible on the EMB agar plates after incubation. Likewise, both pink and black colonies were visible on the Salmonella Shigella agar plates. Similarly, colonies on Mannitol Salt agar plates were yellow in color. Following that, each of these colonies was subcultured independently on the same kind of medium. Gram staining and a biochemical test were then used to further validate these colonies.

Anti- bacterial activity: The agar well diffusion technique was used to carry out the antibacterial assay. Twenty milliliters of Mueller Hinton Agar medium were added to petri plates, and the mixture was left to solidify. After solidifying, a cotton swab was used to equally distribute a bacterial culture of Shigella, Salmonella, *E. coli*, *Klebsiella*, and *Staphylococcus species* across the agar surface. After removing any extra inoculum, it was let to air dry for five minutes. A sterile cork borer made of stainless steel was used to create wells with a diameter of 5 mm. Each well was given 40 µl or 60 µl of the plant extract after being properly labeled. After that, the plates were incubated for 24 hours at 37° C. The diameter of the inhibition zones encircling the tested bacteria was used to gauge the antibacterial activity.

Result

Isolation of Microorganisms: Five distinct colonies were seen on EMB agar, Mannitol salt agar, and SS agar plates during a 24-hour incubation period.

Fig 1: Smooth, black colour colonies with the production of H2S on SS Agar

Fig 2: Smooth, translucent, moist colonies on SS Agar

Fig 3: Metallic sheen colonies appeared on EMB Agar

Fig 4: Pink mucoid colonies appeared on EMB Agar

Fig 5: Yellow colour colonies on Mannitol Salt Agar

Biochemical test Result

Test name	*Salmonella*	*Shigella*	*Klebsiella*	*E. coli*	*Staphylococcus*
Indole	+	–	–	+	–
Methyl red	–	+	–	+	+
Voges Proskauer	–	–	–	–	–
Citrate	+	–	+	–	+
TSI	K/A with H2S & gas production	A/A with gas production	A/A with gas production	A/A, no gas	A/A
Catalase	+	+	+	+	–
Oxidase	–	–	–	–	–
Gram Staining	–	–	–	–	+

(+) indicates Positive, ***(-)*** *indicates negative*

Anti Bacterial-Activity

S. No	Organism Name	Aqueous extract		Ethanol extract	
		40µl	60µl	40µl	60µl
1.	*Salmonella*	9	11	15	18
2.	*Shigella*	8	14	13	19
3.	*Klebsiella*	13	17	21	27
4.	*E. coli*	12	16	18	25
5.	*Staphylococcus*	20	30	23	32

Discussion

Several works have been done to evaluate the phytochemical compositions and antimicrobial activities of different parts of diverse plants, with the aim of using these plants for the treatment of microbial infection as possible alternatives to synthetic drugs to which many infectious microorganisms have developed resistance (Ighodaro OM *et al.*, 2012). Effect of plant constituents can combat human and plant pathogenic bacteria, fungi and viruses without toxic side effects and environmental hazards (Hsieh PC *et al.*, 2001). Some workers said that banana should be considered to be a good source of natural antioxidant and antibacterial and these criteria can be used to produce natural dyes extracted from banana peel to color cotton fabrics and protect them from bacterial effects 20. In addition to that banana peel extract not only inhibit the non-spore forming bacteria but also certain studies conclude that unidentified substance extracted from banana skin has been shown to inhibit *Clostridium sporangium* and other gram-negative spore forming bacteria by using plate biological assay, the unknown substance demonstrate inhibitory effects at pH values as high as 7.5 (Aldean AA *et al.*, 2010).

Conclusion

The genus Musa belongs to the Musaceae family, which also includes plantains and bananas, and the zingiberals order. Recent research have extensively examined the antibacterial qualities of extracts from banana peels. More investigation into the solvent and aqueous extracts of several banana varieties, such as yellow and green. Banana peels, which are frequently seen as waste, may be a potential source of natural antibacterial agents, as these extracts shown a promising antibacterial action. This demonstrates the potential of using extracts from banana peels to create plant-based, alternative antibacterial medicines, especially for bacterial diseases that are resistant to traditional antibiotics. Therefore, more research into the use of these extracts may result in novel, long-lasting therapeutic benefits in medical treatment.

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