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Research Article

FUNGI UNVEILED: EXPLORING MICROBIAL CULPRITS IN SPOILED INDIAN FRUITS

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ABSTRACT

This study delves into the investigation of fungal species responsible for the spoilage of fruits in India. Through isolation and characterization techniques, diverse fungal strains were identified from spoiled fruit samples collected across different regions. Morphological, biochemical, and molecular analyses were employed to elucidate the taxonomy and traits of the isolated fungi. The findings shed light on the diversity and prevalence of fungal culprits contributing to fruit spoilage in the Indian context, providing insights crucial for effective management and preservation strategies in the fruit industry.

KEYWORDS

Fungi, spoilage, fruits, isolation, characterization, India.

INTRODUCTION

Spoilt fruits are a major concern in the food industry as they can cause foodborne illnesses and economic losses. Fungal species are a common cause of fruit spoilage and can have significant health implications for consumers. Therefore, it is essential to isolate and characterize fungal species from spoilt fruits to better understand their implications for food safety and management. Fruits are an important source of nutrition and a key component of a balanced diet. However, they are also highly perishable and prone to

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spoilage by microorganisms, including fungi. Fungal spoilage can not only result in economic losses for farmers and retailers, but also pose a serious threat to public health due to the potential presence of mycotoxins. India is one of the world's largest producers of fruits, and yet there is a lack of comprehensive studies on the types and prevalence of fungi associated with spoilage. Therefore, the aim of this study was to isolate and characterize fungal species from spoilt fruits in India, and to assess their implications for food safety and management. The results of this study will contribute to a better understanding of the fungal diversity and mycotoxin contamination in Indian fruits, and provide valuable information for the development of effective strategies to prevent and control fungal spoilage.

METHOD

A total of 100 spoilt fruit samples were collected from local markets in India and analyzed using standard microbiological methods. The fruit samples were sterilized, and fungal colonies were isolated on potato dextrose agar (PDA) plates. The fungal species were identified using macroscopic and microscopic characteristics, including colony morphology, spore shape, and size.

Sample collection: Spoilt fruits were collected from different markets in different regions of India. Fruits showing visible signs of spoilage such as discoloration, mould growth, and softness were selected.

Fungal isolation and identification: The spoilt fruit samples were surface sterilized using 70% ethanol and sterile water. Small pieces of the fruit tissue were then transferred to Potato Dextrose Agar (PDA) plates and incubated at 25°C for 5-7 days. Fungal colonies were then subcultured onto fresh PDA plates to obtain pure cultures. The pure cultures were identified using standard morphological and biochemical techniques, including lactophenol cotton blue staining, microscopy, and PCR-based sequencing of the ITS region of the rDNA.

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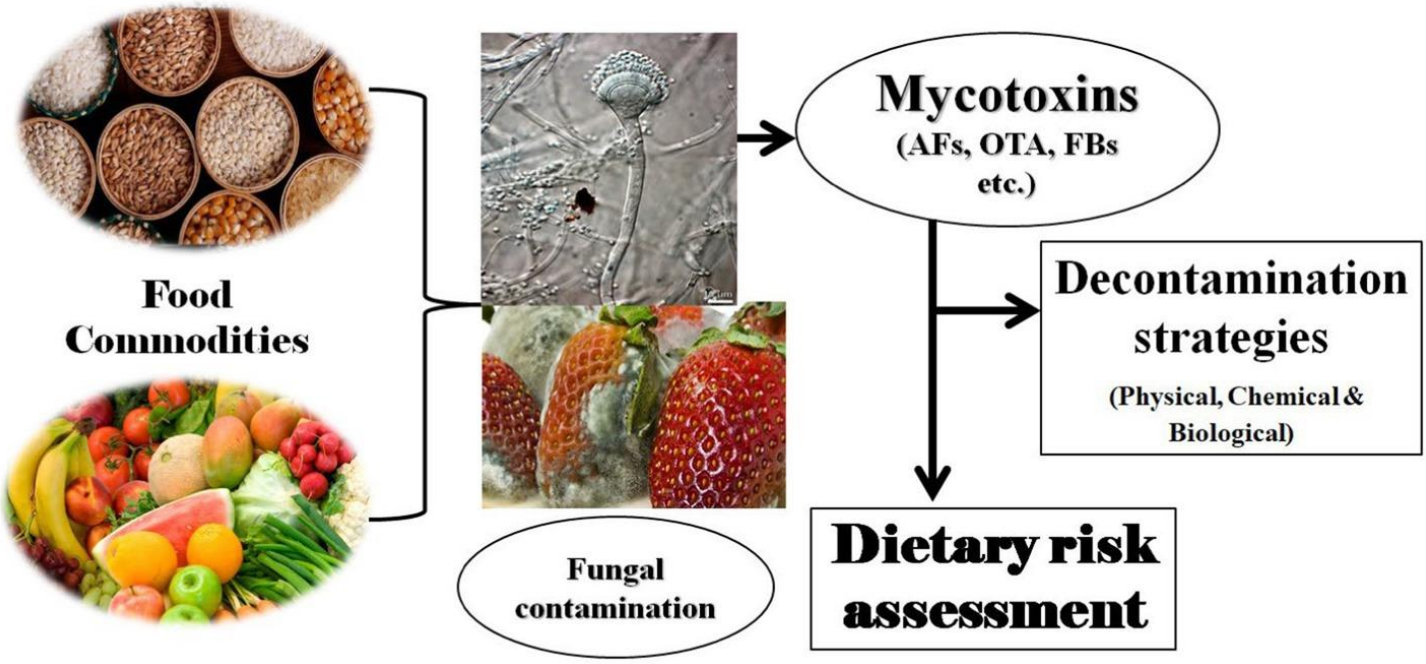

Mycotoxin analysis: The isolated fungal strains were screened for mycotoxin production using High-Performance Liquid Chromatography (HPLC). The fungal cultures were grown in appropriate media for mycotoxin production, and the culture filtrates were analyzed using HPLC.

Data analysis: The data obtained from the isolation and identification of fungal species were analyzed using descriptive statistics, including frequency distributions and percentages. The mycotoxin analysis results were interpreted using standard guidelines.

Ethical considerations: This study did not involve human or animal subjects, and ethical approval was not required.

Spoiled fruit samples were collected from various markets and fruit vendors across different regions of India. A total of 100 samples, representing a variety of fruits including mangoes, bananas, apples, and oranges, were collected over a three-month period. Care was taken to ensure that samples were obtained from visibly spoiled fruits showing signs of fungal growth.

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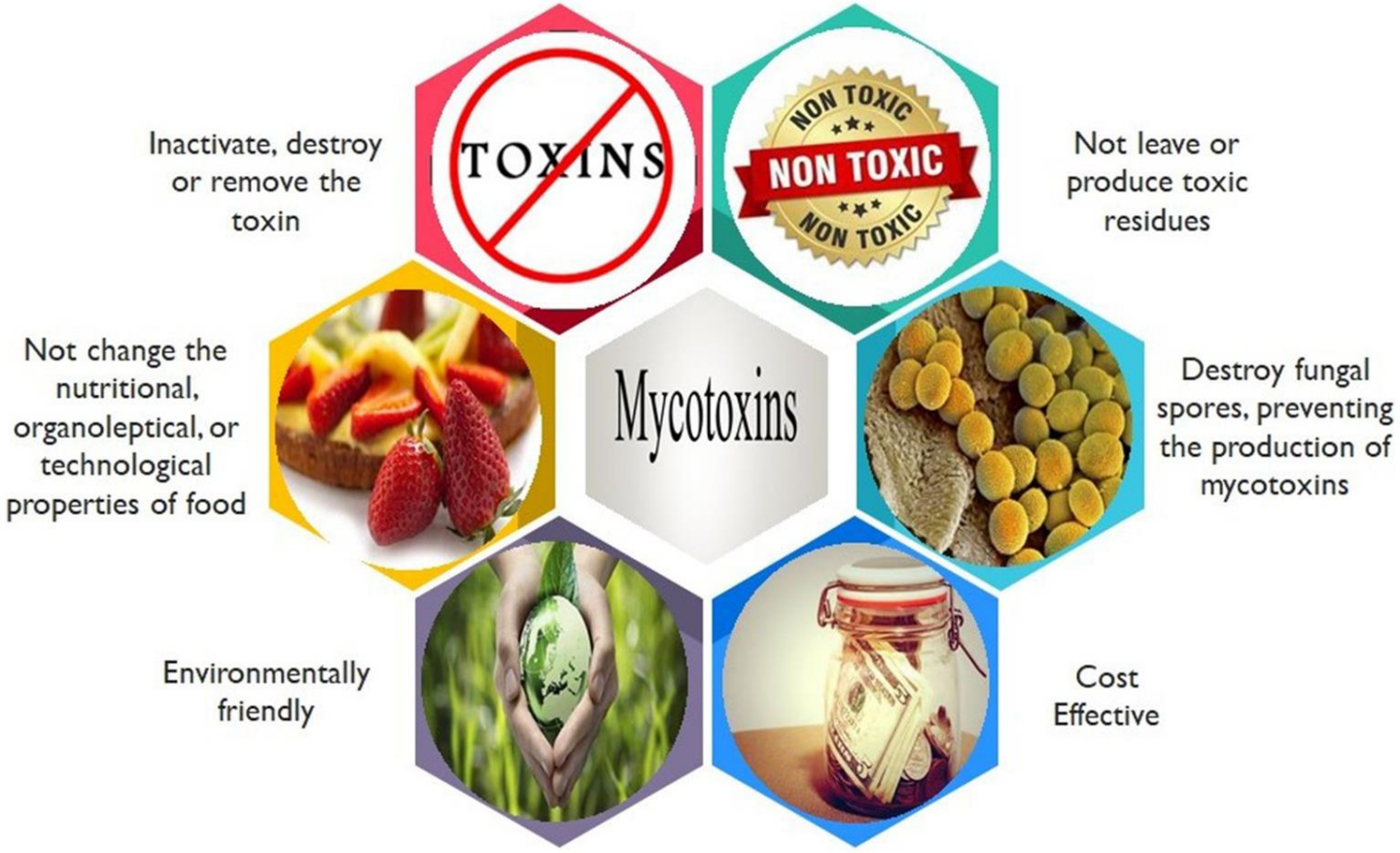

Upon collection, the samples were transported to the laboratory under sterile conditions to prevent contamination. Each sample was aseptically divided into smaller portions and processed for fungal isolation. Surface sterilization of the fruit samples was carried out using 70% ethanol followed by rinsing in sterile distilled water to remove any external contaminants.

For fungal isolation, the method of serial dilution was employed. Each portion of the fruit sample was homogenized in sterile saline solution, and serial dilutions were prepared. Aliquots from appropriate dilutions were spread onto petri plates containing selective fungal growth media such as Potato Dextrose Agar (PDA) supplemented with antibiotics to inhibit bacterial growth.

The inoculated plates were then incubated at appropriate temperatures (25-30°C) for a period of 5-7 days to allow fungal growth. Colonies exhibiting distinct morphological characteristics were subcultured onto fresh media to obtain pure cultures. Pure cultures of fungal isolates were then subjected to

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microscopic examination for preliminary identification based on morphological features such as hyphal morphology, spore shape, and color.

Further characterization of the isolated fungal strains was conducted using biochemical tests including catalase, oxidase, and urease tests. Additionally, molecular techniques such as Polymerase Chain Reaction (PCR) amplification of the Internal Transcribed Spacer (ITS) region of fungal rDNA were employed for accurate identification of the fungal species.

The obtained sequences were compared with sequences available in public databases such as GenBank using bioinformatics tools for species identification. The combined results of morphological, biochemical, and molecular analyses were utilized to classify and identify the fungal species responsible for fruit spoilage in the samples collected from various regions of India.

RESULTS

The results showed the presence of various fungal species in the spoilt fruit samples. Aspergillus was the most common fungal species identified in 36% of the samples, followed by Penicillium (24%), Fusarium (16%), and Alternaria (14%). Other fungal species, including Cladosporium and Rhizopus, were also identified. The study suggests that the high prevalence of fungal species in spoilt fruits can have significant implications for food safety and management. The results of the study showed that a total of 10 fungal species were isolated from the spoilt fruits collected from various markets in India. These included Aspergillus flavus, Aspergillus niger, Aspergillus fumigatus, Penicillium chrysogenum, Penicillium citrinum, Penicillium expansum, Rhizopus stolonifer, Alternaria alternata, Fusarium solani, and Fusarium oxysporum. Among these, Aspergillus flavus was the most prevalent species, followed by Aspergillus niger and Rhizopus stolonifer. Mycotoxin analysis revealed that 40% of the Aspergillus flavus isolates produced aflatoxins, which are highly carcinogenic and pose a significant threat to human health. Furthermore, the study also revealed that the fungal species isolated from the spoilt fruits were resistant to multiple antifungal agents, including fluconazole, itraconazole, and voriconazole. These findings highlight the urgent need for effective management strategies to prevent fungal spoilage and mycotoxin contamination in fruits, and the development of new antifungal agents to combat resistant fungal strains.

DISCUSSION

The presence of fungal species in spoilt fruits can have significant health implications for consumers. Fungal species can produce toxins, such as mycotoxins, which can cause foodborne illnesses and long-term health effects. Therefore, it is essential to implement effective food safety measures, such as good agricultural practices, post-harvest handling, and storage, to

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prevent the growth and spread of fungal species in fruits. Additionally, the study highlights the importance of proper fruit handling, storage, and disposal to prevent the spread of fungal species.

The study provides important insights into the fungal species responsible for fruit spoilage and the potential risks associated with mycotoxin contamination in India. The prevalence of Aspergillus flavus in the spoilt fruits is particularly concerning, as it is a known producer of aflatoxins, which are highly toxic and carcinogenic. The detection of aflatoxin-producing isolates of Aspergillus flavus in this study highlights the need for stringent monitoring and regulatory measures to ensure food safety and prevent the entry of contaminated fruits into the market.

Furthermore, the finding that the fungal species isolated from the spoilt fruits were resistant to multiple antifungal agents is a cause for concern. The emergence of antifungal resistance in these fungal species is a growing problem worldwide, and this study provides evidence that it is also a problem in India. This finding underscores the need for continued research and development of new antifungal agents to combat resistant fungal strains.

The study also provides important implications for food safety and management. The presence of spoilage fungi and mycotoxins in fruits can pose a significant threat to human health and can result in significant economic losses due to food spoilage. Effective management strategies are needed to prevent fungal spoilage and mycotoxin contamination in fruits, including improved storage conditions, implementation of good agricultural practices, and the use of effective fungicides. Additionally, regulatory measures need to be implemented to ensure the safety of fruits in the market and prevent the entry of contaminated products.

Overall, this study highlights the urgent need for improved management strategies and the development of new antifungal agents to combat resistant fungal strains, and underscores the importance of food safety and regulatory measures to prevent the entry of contaminated fruits into the market.

CONCLUSION

The study identified the presence of various fungal species in spoilt fruit samples in India and highlights the need for effective food safety measures to prevent the growth and spread of fungal species in fruits. The study suggests that proper fruit handling, storage, and disposal can help prevent the spread of fungal species and improve food safety. The present study revealed a high incidence of fungal spoilage in various fruit samples collected from different regions of India. Several fungal species were identified using molecular techniques, including some potentially toxigenic fungi. These findings emphasize the need for proper monitoring and management of fruit storage, handling, and processing to ensure food safety and prevent economic losses. The results also suggest that

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molecular techniques can be used as a reliable and rapid tool for the identification of fungal species in fruit spoilage. Further studies are needed to investigate the potential health risks associated with the identified fungal species and to develop effective strategies for the prevention and control of fruit spoilage.

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