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PREVALENCE AND DIVERSITY OF SPOILAGE FUNGI IN POST-HARVEST STRAWBERRIES FROM VASHI FRUIT MARKET, NAVI MUMBAI

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ABSTRACT

The current study investigated the aeromycoflora of the APMC fruit market in Vashi, Navi Mumbai, Maharashtra, India, conducted over two consecutive seasons from January to February 2023 and January to February 2024. Strawberry fruits (*Fragaria ananassa* Duchesne) were abundant in the market during this period. The aeromycological assessment utilized the gravity slide method and Petri plate exposure to establish a correlation between airborne fungi and the decay of Strawberries. A total of 25 aeromycoflora were identified in the market's air, with *Penicillium expansum*, *Botrytis cinerea*, and *Mucor piriformis* emerging as the primary causative agents of Strawberry fruit rot and subsequent losses.

KEYWORDS: Strawberries, APMC fruit market, aeromycoflora.

INTRODUCTION

The growth of filamentous fungi in highly perishable fruits, such as Strawberries, poses a significant quality issue and contributes to substantial economic losses. This study focuses on the aeromycoflora of the Vashi APMC fruit market, emphasizing the fungi affecting Strawberries. A total of 25 fungal species were identified, including *Sphaeropsis pyriputrescens*, *Venturia inaequalis*, *Botrytis cinerea*, *Alternaria alternata*, *Mucor piriformis*, *Aspergillus fumigatus*, *A. flavus*, *A. tenuis*, *A. niger*, *Phytophthora cactorum*, *Phytophthora parasitica*, *Sclerotinia fructigena*, *Rhizopus nigricans*, *Rhizopus stolonifer*, *Rhizopus arrhizus*, *Penicillium chrysogenum*, *Penicillium citrinum*, *Penicillium*

digitatum, *Penicillium funiculosum*, *Penicillium italicum*, *Penicillium solitum*, *Penicillium commune*, *Penicillium regulosum*, *Penicillium expansum*, and *Curvularia lunata*. These fungi were categorized as pathogenic and non-pathogenic, with *Penicillium expansum*, *Botrytis cinerea*, and *Mucor piriformis* being the dominant pathogens causing severe post-harvest diseases like blue mold, gray mold, and Mucor rot in Strawberries.

The study highlights that atmospheric biopollutants, particularly fungal spores, play a critical role in causing diseases in fruits and vegetables during post-harvest stages, including packaging, transit, transshipment, and storage. Previous research, such as studies by Tilak and Kulkarni (1980), Sharma and Bhattacharjee (2001), and Medhi and Sharma (2010), has similarly documented the aeromycoflora in crop fields and fruit markets, linking them to significant post-harvest diseases in fruits like papaya, banana, citrus, pineapple, and cereals like rice, wheat, and bajra, while Chenulu and Thakur (1968) identified *Aspergillus niger* and *Rhizopus oryzae* as major pathogens in Delhi fruit markets.

In the Vashi market, Strawberries were particularly susceptible to microbial decay due to fungal invasions. This decay was observed in packaging boxes and storage conditions within local and central fruit markets across Maharashtra, India, particularly in Mumbai and Navi Mumbai. The aeromycoflora composition in markets is influenced by factors such as topography, meteorological conditions, vegetation, and human activity. The study also underscores potential health implications for workers, sellers, and customers exposed to fungal aerospores in the market environment. Among the identified pathogens, *Penicillium expansum*, *Botrytis cinerea*, and *Mucor piriformis* were noted as major contributors to post-harvest losses in Strawberries, consistent with findings by Spotts *et al*. (1999) in commercial storage facilities.

MATERIALS AND METHODS

A consecutive survey was conducted from January to February 2023 and January to February 2024 at the APMC fruit market in Vashi. Air sampling was performed at two-week intervals in the Strawberry section of the market using gravity slide and Petri plate exposure methods with Czapek's Dox Agar Medium. Petri plates were exposed to the air at varying durations—0, 5, 10, and 15 minutes, and at different heights: ground level (0 cm), 500 cm, 1000 cm, and 2000 cm above ground level to capture aeromycoflora. The agar plates were incubated at a temperature of (28±2) °C for seven days. After the incubation period, colony characteristics and cultural patterns were studied, and aeromycoflora were identified using relevant

literature. A total of 25 fungal species were identified in the APMC fruit market at varying heights and exposure durations, contributing valuable insights into the aeromycoflora composition. (Sreeramulu, 1959; Asan et al., 2002; Uddin, 2004).

RESULTS AND DISCUSSION

A total of 25 fungal species were identified from the air of the APMC fruit market in Vashi using gravity slide and agar plate exposure methods. The fungi observed included *Sphaeropsis pyriputrescens*, *Venturia inaequalis*, *Botrytis cinerea*, *Alternaria alternata*, *Mucor piriformis*, *Aspergillus fumigatus*, *A. flavus*, *A. tenuis*, *A. niger*, *Phytophthora cactorum*, *Phytophthora parasitica*, *Sclerotinia fructigena*, *Rhizopus nigricans*, *Rhizopus stolonifer*, *Rhizopus arrhizus*, *Penicillium chrysogenum*, *Penicillium citrinum*, *Penicillium digitatum*, *Penicillium funiculosum*, *Penicillium italicum*, *Penicillium solitum*, *Penicillium commune*, *Penicillium regulosum*, *Penicillium expansum*, and *Curvularia lunata*. Agar plates were exposed for 0, 5, 10, and 15 minutes at various heights (ground level, 500 cm, 1000 cm, and 2000 cm), enabling the trapping of fungal spores at different time intervals and heights shown in Table 1 and Table 2.

It was observed that *Sphaeropsis pyriputrescens*, *Rhizopus nigricans*, *Rhizopus stolonifer*, and *Rhizopus arrhizus* were absent at the height of 2000 cm. The most dominant fungi identified on agar plates included *Alternaria alternata*, *Aspergillus fumigatus*, *Aspergillus flavus*, *Aspergillus niger*, *Botrytis cinerea*, *Penicillium funiculosum*, *Penicillium digitatum*, *Rhizopus stolonifer*, *Mucor piriformis*, and *Penicillium expansum*. Among these, *Penicillium expansum*, *Botrytis cinerea*, and *Mucor piriformis* were particularly severe on Strawberries, being recorded at different heights.

Most fungal species, including *Sphaeropsis pyriputrescens*, *Venturia inaequalis*, *Botrytis cinerea*, *Alternaria alternata*, *Mucor piriformis*, *Aspergillus fumigatus*, *A. flavus*, *A. tenuis*, *A. niger*, *Phytophthora cactorum*, *Phytophthora parasitica*, *Sclerotinia fructigena*, *Rhizopus nigricans*, *Rhizopus stolonifer*, *Rhizopus arrhizus*, *Penicillium chrysogenum*, *Penicillium citrinum*, *Penicillium digitatum*, *Penicillium funiculosum*, *Penicillium italicum*, *Penicillium solitum*, *Penicillium commune*, *Penicillium regulosum*, *Penicillium expansum*, and *Curvularia lunata*, were predominantly found at ground level, followed by heights of 500 cm, 1000 cm, and 2000 cm. Similarly, the maximum fungal growth was observed at a 15-minute exposure time, followed by 10, 5, and 0 minutes. Longer exposure durations allowed more fungal spores to settle on the agar plates. These findings align with previous reports by Lim

and Rohrback (1980) and Padmanabhan *et al*. (1953).

Table 1: Frequency of occurrence of mycoflora at different height (cm) in the market of strawberries.

Fungi	Height (cm)			
	Ground level (0)	500	1000	2000
Sphaeropsis pyriputrescens	+++	++	+	-
Venturia inaequalis	+++	++	+	+
Botrytis cinerea	++++	+++	++	++
Alternaria alternate	+++	++	++	+
Mucor piriformis	++++	+++	++	++
Aspergillus fumigatus	++++	+++	++	+
Aspergillus flavus	++++	+++	++	+
Aspergillus tenuis	++++	++	++	+
Aspergillus niger	++++	+++	++	+
Phytophthora cactorum	+++	++	++	+
Phytophthora parasitica	+++	++	++	+
Sclerotina fructigena	+++	++	++	+
Rhizopus nigricans	+++	++	+	-
Rhizopus. Stolonifer	++++	+++	++	-
Rhizopus arrhizus	+++	++	+	-
Penicillium chrysogenum	+++	++	++	+
Penicillium citrinum	+++	++	++	+
Penicillium digitatum	++++	+++	++	+
Penicillium funiculosum	++++	+++	++	+
Penicillium italicum	+++	++	++	+
Penicillium expansum	++++	+++	++	++
Penicillium solitum	+++	+++	++	+
Penicillium commune	+++	++	++	+
Penicillium regulosum	+++	++	+	+
Curvularia lunata	++++	+++	+	+

N.B. = +: 25 percent frequency of occurrence of fungal species; ++: 50 percent frequency of occurrence of fungal species; +++: 75 percent frequency of occurrence of fungal species; ++++: 100 percent frequency of occurrence of fungal species.

Table 2: Frequency of occurrence of mycoflora at different periods of exposure in the fruit market strawberries.

Fungi	Different Period of exposure			
	O minutes	5 minutes	10 minutes	15 minutes
Sphaeropsis pyriputrescens	-	+	++	+++
Venturia inaequalis	-	+	++	++
Botrytis cinerea	-	++	+++	++++
Alternaria alternata	-	++	++	+++
Mucor piriformis	-	++	+++	++++

Aspergillus fumigatus	-	++	++	++++
Aspergillus flavus	-	+	+++	+++
Aspergillus tenuis	-	+	+++	+++
Aspergillus niger	-	++	+++	+++
Phytophthora cactorum	-	+	++	+++
Phytophthora parasitica	-	+	++	+++
Sclerotina fructigena	-	+	++	+++
Rhizopus nigricans	-	+	++	+++
Rhizopus. Stolonifer	-	+	++	+++
Rhizopus arrhizus	-	+	++	+++
Penicillium chrysogenum	-	+	++	+++
Penicillium citrinum	-	+	++	+++
Penicillium digitatum	-	+	+++	++++
Penicillium funiculosum	-	+	+++	++++
Penicillium italicum	-	+	++	+++
Penicillium expansum	-	++	+++	++++
Penicillium solitum	-	+	++	+++
Penicillium commune	-	+	++	+++
Penicillium regulosum	-	+	++	+++
Curvularia lunata	-	+	++	+++

N.B. = +: 25 percent frequency of occurrence of fungal species; ++: 50 percent frequency of occurrence of fungal species; +++: 75 percent frequency of occurrence of fungal species; ++++: 100 percent frequency of occurrence of fungal species.

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