

## Fungi associated with postharvest quality deterioration of strawberry at green markets of Lahore

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### Abstract

Strawberry (*Fragaria ananassa* Duch.) enters in fruit markets of Lahore from December and stays till the start of summer. Major supply of strawberry comes from adjacent areas of Lahore city. Being highly perishable crop, strawberries are marketed very wisely by the stakeholders. Because of fluctuation in temperature and unpredictable rains, deterioration by postharvest fungi is accelerated in summer season. In the present study, series of surveys at fortnight interval were conducted in markets and retailer shops during the months of March to May. Quality deterioration in strawberry was assessed by association of postharvest pathogens expressed as % lesion area fruit surface and sensory parameters. Regular sampling from the available markets exhibited inconstant intensity of fungal flora associated with postharvest losses in strawberry. Potential causal agents from fruit surface and pulp were transferred to potato dextrose agar using different isolation techniques and incubated at 25±2 °C. Isolated pathogens were characterized into surface and pulp contaminants on the basis of their association. A total of 5 fungi *M. fragalis*, *M. genevensis*, *A. niger* and *A. fumigatus* and one unknown were isolated from rotting strawberries. Among isolated fungi, four were grouped under surface adherents and one as pulp contaminant. Surface associated fungi had high occurrence frequency (80%) as compared to fungi isolated from pulp (20%). Identification was performed by macro- and microscopic observation of colonies characters growing on malt extract agar medium. Pure cultures of isolated fungi were identified with the help of key developed by Barent and Hunter and submitted to Fungal Culture Bank of Pakistan. It was first report of postharvest fungi associated with strawberry available in Lahore markets.

**Keywords:** Deterioration, Packaging materials, Perishable, Postharvest fungi, Strawberry.

### Introduction

Strawberry is a non climactic perennial herb that belongs to family Rosaceae. It is advised to harvest fruit on achieves its physical maturity. According to the archaeological references, its commercial scale production was started in America in nineteenth century. It is liked by every age group because of its great sweet, tart, taste and nutritional value. It is rich in vitamin C, sugar, organic acids and minerals. It is available in markets as fresh fruit and fruit based products like juice, jam and candies etc. (Hakkinen and Torronen, 2000). Strawberries also comprises the non-nutrients e.g. flavonoids and phenolic, with high percentage as compared to others berry fruits. High nutritive values provide strawberry with heart protecting, anticancer and anti-inflammatory qualities (Sun *et al.*, 2002)

According to the available reports its being cultivated on 78 ha. and cultivated in specific areas of Punjab and KPK provinces. In Sindh Province selective growers are engaged in its cultivation on experimental bases. Whereas Charsada and Mangora districts of KPK are famous for its nurseries. According to international standards of fruit trade, key quality attributes considered are the flavour and nutritional value of fruit along with fruit firmness, turgidity and disease free appearance.

Strawberry is highly perishable fruit even under ideal conditions of storage at 4 °C it losses its

edible quality within a week (Wills *et al.*, 1998). Strawberry fruit is subjected to a number of diseases during postharvest storage. Among these, gray mold anthracnose fruit rot (*Colletotrichum acutatum*), leather rot (*Phytophthora cactorum*) and Rhizopus rot (*Rhizopus stolonifer*) are of significance importance. Fruit is highly sensitive to shipment constraints like temperature fluctuations and mechanical injuries. Market shipment negative factors lead to it pathogenic quality deterioration and shortening of shelf life.

### Materials and Methods

#### Selection of markets

Three vegetable markets of Lahore (Latitude 31.57 N and longitude 74.31 E) namely Badami Bagh (Main vegetable trade point), Allama Iqbal Town and Kot Lakhpat (at periphery) were selected for investigations on the basis of marketing network and business volume. The surveys were conducted during the months of March to May. In the market, fruits were classified on appearance of the fruit. Physical appearance classification of the fruit on 0-5 rating scale was developed where 0 means 1<sup>st</sup> rate good and 5 means very poor and beyond that fruit is discarded and not liked by any one of the consumer class.

### Isolation of postharvest fungi from strawberry


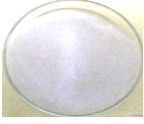


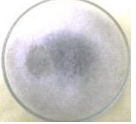


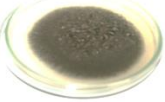


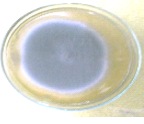


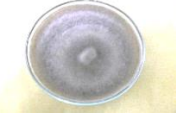
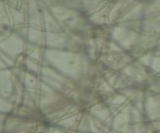
Samples were brought to the laboratory in separate sterilized polythene bags (Malik, 1996). The Strawberry fruits were disinfected by dipping in sterilized distilled water until all dust particles were removed and dried with sterilized paper towel. Isolation from ecto- and endodermis was made by routine isolation techniques (Montazeri *et al.*, 2006). Isolation from strawberry pulp was done with amendments. Pulp was made by homogenizing surface sterilized cut portion of strawberry with the help of pastel and mortar. Pulp and surface sterilized tissues were inoculated into Petriplates containing potato dextrose agar growth medium and incubated at 26 °C. The following morphological

characteristics *viz.* colony growth, colony colour and spore shape were recorded (Barnett and Hunter, 2003). Infection in tissue was stained with cotton blue and lactophenol, and observed under compound microscope.

### Pathogenicity test

To justify Koch's postulates, a spore suspension of 30 µL was prepared from 7 days old cultures and was inoculated in fresh skin wounds made with a sterile stainless-steel rod with a probe tip 1 mm wide and 2 mm in length and were kept at room temperature in plastic trays. In control strawberry fruits were inoculated with sterile water.

**Table 1:** Post harvest fungi associated with strawberry.

Fungus	Infection on strawberry	Colony of isolated fungi	Microscopic image 40X
<i>Mucor fragilis</i>			
<i>Mucor genevensis</i>			
<i>Aspergillus niger</i>			
<i>Aspergillus fumigatus</i>			
Unidentified			

## Results and Discussion

Storage and transportation losses of fruits in all over the world are mostly caused by fungi. In the present investigation, it was discovered in surveys of different fruits markets that postharvest decay is also a major cause of losses of strawberry during storage and marketing. Samples were collected from fruits markets of Lahore. Information regarding strawberry types and availability were also gathered during the visits. Investigations revealed that postharvest decay was more prevalent during storage in market from March to May and susceptibility of freshly harvested strawberries to postharvest pathogen increased because of ambient environmental conditions for the growth of fungi (Vicente *et al.*, 2006). A total of five different postharvest fungi were isolated from strawberry. Isolated fungi were grouped into ecto- and endodermis (pulp) contaminants on the basis of their association with strawberry fruit and were identified as *M. fragalis*, *M. genevensis*, *A. niger* and *A. fumigatus* (Table 1)

The isolated fungi were identified on the basis of macro- and micromorphological characteristics (Barnett and Hunter, 1998). Whereas one fungus isolated from strawberry pulp was unidentified. *Mucor* species were found more prevalent than any other species isolated in this study. *Mucor* species were considered as minor postharvest pathogens, however, they have caused serious decay of strawberries, pears, apples, guavas, tomato potato in last two decades (Michailides and Spotts, 1990). Other groups of postharvest fungi which were isolated more frequently belonged to genera of *Aspergillus*. Postharvest decays of pears, apples, peaches, grapes, strawberries, melons and tomatoes. have been associated earlier with species of *Aspergillus*. *A. niger* was commonly isolated from most of the fruits during storage followed by *A. flavus*, which was infrequently isolated from stored grapes, tomatoes and peaches. Moreover, Thomidis and Exadaktylou (2012) first time reported postharvest rots of cherries by *Aspergillus flavus* in Greece. Appearance of mycelial growth of fungi on fruits on the 2<sup>nd</sup> day confirmed the pathogenicity of isolated fungi while control remained healthy. All the isolated fungi were successfully re-isolated, fulfilling Koch's postulates. First report of postharvest rot and mummification of strawberry fruits by *Neofusicoccum parvum* and *N. kwambonambiense* in Brazil was given by Lopes (2014). This is the first report of fungi causing

strawberry decay and rot during storage in markets of Lahore, Pakistan.

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