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FUNGI ASSOCIATED WITH THE SPOILAGE OF POST HARVEST TOMATO FRUITS IN DIFFERENT MARKETS OF JABALPUR, MADHYA-PRADESH, INDIA.

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ABSTRACT

Market survey of Jabalpur city for post harvest fungal pathogens of tomatoes revealed occurrence of *Aspergillus niger*, *Geotrichum candidum*, *Alternaria solani*, *Mucor racemosus*, *Aspergillus flavus*, *Fusarium oxysporum*, *Fusarium monilliforme*, *Penicillium digitatum* and *Rhizopus stolinifer*. Result showed highest occurrence of *Aspergillus niger* followed by *Alternaria solani* in rainy season. *Geotrichum candidum* showed dominance in winter season. Least frequently occurred was that of *Mucor racemosus*. Highest fungal infection was recorded during month of April to October. Study was carried out to isolate, characterize and identify the fungi causing fungal infection on tomatoes. Pathogenicity test revealed that all these fungi were pathogenic. Investigation in different Jabalpur markets revealed that fungal diseases mainly occurred due to injury during transportation, storage and handling.

KEYWORDS: Tomato, fungal infection, Post-harvest and Jabalpur markets.

INTRODUCTION

Tomato is widely used, eaten in both raw and processed forms (Moneruzzaman *et al.*, 2008). It is small, annual and short lived perennial herb, dicotic and angiospermic plant belongs to family solanaceae. It was originated from South America and entered to Europe in 16th century, later to East Africa in the early 1900 (Wamache, 2005). Tomato is rich in vitamins, Carbohydrates, proteins, fats and potassium (Talvas *et al.*, 2010). Richest source of lycopene is present in tomatoes which has been found to prevent prostrate cancer (Evangelia *et al.*,

2005). It is highly perishable and contains large amount of water due to which it is more susceptible to fungal infections. Post harvest handling, storage, transportation and marketing are seriously affecting the quality of tomatoes. Tomato fruit rots are mainly caused by bacteria, virus and fungi but mostly deteriorated by fungal diseases. Several fungal species were associated to cause fungal infections in tomatoes. They were *Geotrichum candidum, Rhizopus stolonifer*, black mold rot caused by *Alternaria* sp., and *Fusarium* rot by *fusarium* sp. Tomato contaminated with *Fusarium* species is dangerous for human consumption because they produce mycotoxins (Burgess 1985, Jofee 1986, Nelson *et al.*, 1990). Magnitude of post harvest losses in fresh tomato fruits is to be estimated 25.80% (Thirupathi *et al.*, 2006). It is extremely difficult to harvest tomatoes without causing any injury. Fungal rots on tomatoes are worldwide problem. *Alternaria* rot has been considered a common diseases and causes huge losses to tomatoes thus making tomatoes unfit for consumption (Douglas 1922).

Sour rot of tomatoes due to *Geotrichum candidum* is a wound pathogen gets easy chance to enter in injured portion (Brown 1979, Carmo-Sousa 1965, Gutter 1978, Lewis and Sinclair 1966, Mahmood 1970 and Moris 1982). The magnitude of post-harvest losses always vary from one country to another country and one season to another and even one day to another (Mujib *et al.*, 2007). Control of tomato rots always remain challenge for researchers.

Huge losses has forced to researchers for simple effective and economic methods to control post harvest diseases and other losses in tomatoes (Wilson and Wisniewski 1989). Post harvest practices include harvesting, storage, processing, packaging, transportation and marketing (Merema and Rolle, 2002). These post harvest losses are more severe in developing than developed nations (Enyiukwu, 2014).

MATERIALS AND METHODS

1. Sample collection

One hundred fifty infected tomato fruits and fifty fresh tomato fruits were collected from ten different markets of Jabalpur madhya pradesh. They were brought to Mycological lab Department of Biological Science RDVV Jabalpur in sterile polythene bags.

2. Material sterilization

All the glassware were properly washed in chromic acid solution, dried and sterilized in hot air oven at 160^0C for one hour.

3. Isolation of Associated fungi.

Infected samples were first washed with running tap water. An appropriate size of spoilt tomatoes were carefully cut with the aid of sterile blade then sterilized with 70% ethanol and rinsed in sterile distilled water. Sliced portion were then plated on sterile PDA medium and 2% tetracycline was used to inhibit bacterial growth and then incubated at $26+1^0$C. Incubation was carried out in inverted positions of petriplates for 4-6 days. The colonies thus developed are repeatedly subcultured on PDA medium to obtain pure cultures. Isolations were identified based on cultural and microscopic characteristics and compared with standard mycological texts. (Donsch *et al.*,1980, Burnett and Hunter 1992).

4. Pathogencity test of isolates

The procedure of (Chukwuka *et al.*, 2010 and Onurach *et al.*, 2015) was used in pathogencity test. Twenty fresh tomato fruits were properly washed and surface sterilized with 70% ethanol. Sterile cork borer was used to bore holes in each tomato fruits. Mycelial discs were lifted from pure cultures and introduced directly into the holes, Petroleum jelly was used to prevent contamination and entry of pathogens.

Another twenty fresh tomato fruits were wounded with sterile cork borer but were not infected with fungi act as controls. Inoculated tomato fruits and controls were incubated at 28^0C for seven days and observed for the results. Fungi were isolated and compared with orginal fungal isolates (Muhammad *et al.*, 2004).

RESULTS

The result obtained from this study indicated that nine different fungi were associated with post harvest rots of tomatoes in different markets of Jabalpur Madhya pradesh India. The isolated fungi were *Aspergillus niger, Alternaria solani, Geotrichum candidum, Fusarium oxysporum, Rhizopus stolonifer, Aspergillus flavus, Penicillium digitatum* and *Mucor racemosus*. Highest frequency of occurrence was observed in *Aspergillus niger* followed by *Alternaria solani* and *Geotrichum candidum* was dominant in winter season. *Mucor racemosus* shows least dominanace as a tomato rot.

Table 1.Fungal isolates from the spoilt tomato fruits in different markets of Jabalpur.

Markets	Fungal isolates
Sadar market	*Aspergillus niger, Geotrichum candidum* and *Fusarium oxysporum*.
Fuwara market	*Aspergillus niger, Aspergillus flavus, Fusarium oxysporum, Alternaria solani, Rhizopus stolonifer, Penicillium digitatum* and *Geotrichum*

	candidum
Ranital market	*Aspergillus niger, Aspergillus flavus, Alternaria solani, Mucor racemosus, Geotrichum candidum* and *Fusarium oxysporum*.
Adhartal market	*Aspergillus niger, Penicillium digitatum, Geotrichum candidum* and *Alternaria solani.*
Omti market	*Aspergillus niger* and *Geotrichum candidum*.
Hanumantal market	*Aspergillus niger, Mucor racemosus, Fusarium oxysporum* and *Fusarium monilliforme.*
Bilhari market	*Aspergillus niger, Geotrichum candidum, Alternaria solani, Fusarium oxysporum* and *Aspergillus flavus*.
Rasalchok market	*Penicillium digitatum, Aspergillus niger, Rhizopus stolonifer*, and *Alternaria solani.*
Gorakhpur market	*Aspergillus flavus* and *Fusarium oxysporum*.
Radichok market	*Aspergillus niger, Rhizopus stolonifer* and *Alternaria solani*.

Aspergillus niger occurred more frequently in different markets of Jabalpur While least frequently occurred was *Mucor racemosus*.

Table 2. Percentage occurrences of fungal isolates in the spoilt tomatoes from different markets of Jabalpur.

Fungi	% Occurrences.
Aspergillus niger	47.12 %
Alternaria solani	35.34 %
Geotrichum candidum	22.10 %
Fusarium oxysporum	18.23 %
Rhizopus stolonifer	17.9 %
Aspergillus flavus	12.8 %
Fusarium monilliforme	6.3 %
Penicillium digitatum	3.64 %
Mucor racemosus	3.21 %

Table 3.Rot diameter of different fungi in healthy tomato fruits from different markets of Jabalpur.

Fungi	Rot diameter
Aspergillus niger	25 mm
Alternaria solani	13 mm
Geotrichum candidum	10 mm
Fusarium oxysporum	11 mm
Rhizopus stolonifer	19 mm
Aspergillus flavus	14 mm
Fusarium monilliforme	16 mm
Penicillium digitatum	11 mm
Mucor racemosus	12 mm

The rot diameter in healthy tomato fruits is presented in table 3. *Aspergillus niger* had the highest rot diameter of 25 mm followed by *Rhizopus stolonifer* of 19 mm while *Geotrichum candidum* had the lowest rot diameter of 10 mm.

DISCUSSIONS

Result obtained from our study indicated that tomatoes in different markets of Jabalpur are contaminated by following different fungal pathogens, *Aspergillus niger, Alternaria solani, Geotrichum candidum, Fusarium oxysporum, Rhizopus stolonifer, Aspergillus flavus, Fusarium monilliforme, Penicillium digitatum* and *Mucor racemosus*. This is in agreement with the findings of (Kutama *et al.*, 2007).

Aspergillus niger being dominant in different markets of Jabalpur followed by *Alternaria solani* and *Geotrichum candidum*. *Aspergillus niger* produces volatile compounds in spoilt tomatoes (Baker 2006). (Akinmusire, 2011) reported that *Rhizopus* sp. cause great losses to tomatoes.

Distribution of Fungal species in different markets of Jabalpur indicated that Fuwara vegetable market has the highest number of fungal species causing great looses to tomatoes followed by Ranital vegetable market and Gorakhpur vegetable market recorded lowest fungal species causing losses to tomatoes. Frequency of occurrence of fungi in relation to different markets showed that *Aspergillus niger* had the highest frequency of occurrences of 47.12% followed by *Alternaria solani* 35.34% while *penicillium digitatum* and *Mucor racemosus* had the lowest frequency of occurrences 3.64% and 3.2% each. (Ibrahim *et al.*, 2011) reported that *Aspergillus niger* had the highest rate of occurrences in tomato fruits.

Pathogencity test revealed that *Aspergillus niger* produces the highest rot of 25 mm while *Geotrichum candidum* produced the lowest rot of 10 mm in tomato fruits.

CONCLUSION

Tomato fruits were more prone to infection by fungal pathogens than bacteria and viruses. Aspergillus niger appeared to be most active of all the pathogens that result losses of economic resources as well as mycotoxins. Control measures must be employed by vegetable growers, marketers and consumers at the time of harvesting, transportation, handling, storage and processing of tomato fruits

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