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Aeromycological study of fruit and vegetable market of Kolar District, Karnataka

KEYWORDS: Aeromycoflora, Aspergillus, Extramural, Fungal types, Vegetable market

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ABSTRACT *The present study was aimed to investigate aeromycoflora of intramural and extramural vegetable and fruit markets. The study was conducted from two different places namely Kolar and Chintamani. Culture plates were exposed to air at eight centres in vegetable and fruit markets. The colony characteristics of different fungal species were recorded The Aspergillus species colonies were highest in both the study area followed by Penicillium and least colonies were observed in Pestolotia species. The spores and fungal propagules were the major components in the study area. The study provides the overview of the different fungal population in and around the vegetable and fruit markets and to bring awareness to the people about airborne fungal spores and their spoilage in fruits and vegetables and also various allergic disorders caused by this fungus in human beings.*

Introduction

Fungi are ubiquitous in nature and are present in both indoor and outdoor environments. The fungal spores remain suspended for longer time in the air, their presence depend on the various factors like temperature, humidity, sunlight, seasonal variations. Suspensions of organic and inorganic material also effect the distribution of microbes in the air.

Airborne fungi are considered to act as indicator of the level of atmospheric bio-pollution. The presence of fungal spores, volatiles and mycotoxins in the air can cause health hazards in all segments of the population (Kakde *et al*., 2001).Most of these mycotoxins are neurotoxic and carcinogenic for humans. Airborne pathogenic fungi, on the other hand, could cause infections or allergies (Monso, 2004).

The concentration of airborne fungal types in air and their related phenomenon are extensively studied in extramural and intramural environments in India and abroad by great number of investigators, information on their occurrence in the vegetable and fruit markets is in sufficient to compile the data and provide a better forecasting system. There is a relationship between occurrence of air borne fungal spores and market diseases of vegetable and fruits in market environment (Sullia and Khan, 1980). Kolar district (Kolar and Chintamani) is one of the largest producers of vegetables and fruits in Karnataka state. More than 30% of the total produce is lost due to post harvest diseases and decay. The existence of fungal spores as contaminants in air of markets has relation with the incidence of fungal mediated rot of vegetable and fruits.

However, no studies on the incidence of airborne fungal spores in fruit and vegetable markets of Kolar and Chinthamani. Hence, the present study was aimed to investigate aeromycospora responsible for infection and decay of fruits and vegetables in Kolar and Chinthamani markets.

Materials and methods

Study Area

The aeromycological survey was undertaken in the vegetable and fruit market at two different localities of Kolar district, Karnataka. Eight centres were selected for the present study. Outdoor aeromycological survey was conducted around one hundred meter away outside the market. The experimental work was carried out continuously for one year from January to December 2011 comprising all the seasons.

Sterilization

All the glass wares sterilized in hot air oven for about two hrs at 60^0 C and the media sterilized at 121^0 C for 15 minutes in the autoclave.

Preparation of media and incubation

The culture plate exposure method was used for tapping the air mycoflora. Potato Dextrose Streptomycin Agar and Martin's Rose Bengal Streptomycin Agar (Martin, 1950) was used as cultural medium. About 25ml of sterilized media was poured into 9cm diameter petriplates and allowed solidify under aseptic condition. These petriplates were then exposed for 5 minutes at 3 feet above the ground level at 11.00 am. The exposed petriplates were incubated in the laboratory for 7 days at 25 ± 1^0C.

Analysis of fungal types

The plates on third day of incubation were subjected to study fungal types. The plates were further incubated to study slow growing fungi. The semi permanent slides were prepared from these plates, by mounting in lacto phenol cotton blue stain. For the study of conidiophores and conidia Scotch's tape method was employed. The fungi were identified by using valid literature, descriptions and illustrations given by Barnett and Hunter (1972) and Subramanian (1971). The percent incidence occurrence of major fungal types and the total spore (propagules) count per $100cm^2$ were calculated using standard formula.

$$\% \text{ incidence} = \frac{\text{No. of colonies of individual species in all the plates}}{\text{Total No. of colonies of all the species}} \times 100$$

$$\text{Total spore count/ } 100cm^2 \text{ area} = \frac{\text{Total No. of fungal spores}}{\text{Total area of exposure}} \times 100$$

Results and discussion

The aeromycological survey over vegetable and fruit market of Kolar and Chinthamani, revealed the intramural and

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extramural rich aeromycoflora comprising fungal spores and other fungal types. The following fungal types were isolated and studied were represented in the Table 1 and 2 were *Aspergillus sp., Alternaria sp., Clodosporium sp., Curvularia lanata, Candida sp., Drechslera sp., Fusarium sp., Geotrichum sp., Phoma sp., Lasiodiplodia theobromae, Nigrospora sp., Pestalochia sp., Penicillium sp., Pullularia sp., Rhizopus sp.*, etc.

The Intramural and extramural aeromycoflora of vegetable market of Kolar was observed and the total numbers of colonies of all the fungal types in 48 plates were around 569 and 292. Highest number of colonies was found to be *Aspergillus sp.* followed by *Penicillium sp. Cladosporium sp., Pestalotia sp.* and *Geotrichum sp.* (Table.1). A similar result was reported by Pande *et al.* (2012) on incidence of pathogenic types like *Alternaria, Aspergilli, Cladosporium*, *Curvularia* etc. on vegetable and fruit market of Aurangabad. The foregoing observations were in confirmations with the Latha and Ramachandra Mohan (2013) who had studied dominant fungal flora (*Aspergillus*, *Fusarium*, *Alternaria* and *Curvularia*) from outdoor environments of four sites of Jnanabharathi campus of Bangalore. Sullia and Khan (1980) also reported that 70% of aeromycoflora in K.R. Market, Bangalore was constituted by *Aspergillus* and *Penicillium*.

In Chinthamani, the total number of Intramural and Extramural colonies was found to be 571and 325. In Intramural, the highest number of colonies observed was *Penicillium sp.* followed by *Aspergillus sp.*, *Cladosporium sp.* and only one colony in *Stachybotrys sp.* whereas, in Extramural the *Aspergillus sp.* followed by *Penicillium sp.* (Table. 1). Middi Bavaji *et al*. (2012) studied the comparative Aeromycoflora and reported the dominant *Aspergillus* species followed by on different localities and seasons of Tirupati.

The *Penicillium sp.* incidence was maximum in the extramural environment of fruit market at Kolar and in Chinthamani *Aspergillus* incidence was maximum followed by *Alternaria, Cladosporium* and *Curvularia*. These findings are consonance with reports of Talukdar and Bora (2007) conducted the survey at banana market of Tihu of Nalbari district, Assam and reported the highest number of fungal colonies represented by *Aspergillus niger* and *Rhizophus stolonifer.* This fungus spp. was considered to be responsible to cause various diseases.

The less frequent type of fungal genera reported at all the eight study sites were *Botrytis sp., Candida sp., Cephalosporium sp., Drechslera sp., Fusarium sp., Geotrichum sp., Nigrospora sp., Pullularia sp., Phoma sp., Rhizopus sp., etc.* The genera like *Botrytis sp.* and *Cephalosporium sp.* were reported in indoor environment of fruit markets of both the centres. While *Pullularia* and *Candida sp.* were reported from indoor environment of vegetable markets at both the centres. *Corynispora sp*. reported only from intramural atmosphere of vegetable market in Chinthamani.

In consonance with reports of many authors, the incidence of fungal types in the present eight study centres, the total spore count of each of the fungal type in 100cm^2 of exposed area is almost similar (Table. 2). The fore going observations were in confirmation with the reports of workers who had studied the fungal flora from various outdoor and indoor environments. The low incidence of fungal genera like *Fusarium, Cephalosporium, Nigrospora, Pullularia, Drechslera* and *Trichothecium* in the present study is in consonance with the reports of Agashe *et al*. (1983) and Nanda *et al*. (1997).

Conclusion

The present study clearly shows that there is a wide opportunity to study the aeromycoflora of vegetable and fruit markets, local storage places, so as to build the data base of fungal types which can be present in the particular area. Monitoring of fungal spores from indoor and outdoor environments of vegetable and fruit markets help in post harvest management of fungal diseases. The study becomes important to find out the status of various types of allergic and pathogenic spores at various places and their role in causing health hazards to human beings and spoilage of vegetables and fruits.

Table -1. Incidence of major fungal types inside and outside of fruit & vegetable market at Kolar & Chinthamani and their percentage composition to total airspora during the year 2011.

Sl. No	Fungal Types	Kolar taluk								Chinthamani Taluk							
		Fruit market				Vegetable market				Fruit market				Vegetable market			
		Inside		Outside		Inside		Outside		Inside		Outside		Inside		Outside	
		Total	% inc	Total	% inc	Total	% inc	Total	% inc	Total	% inc	Total	% inc	Total	% inc	Total	% inc
1	Aspergillus sp.	112	30.85	64	19.27	162	27.27	81	26.73	92	22.33	76	23.67	147	24.83	91	26.92
2	Alternaria sp.	21	5.78	25	7.35	33	5.55	24	7.59	23	5.58	25	7.78	34	5.74	22	6.50
3	Botrytis sp.	6	1.65	25	7.35	-	-	-	-	9	2.18	2	0.62	-	-	-	-
4	Candida sp.	-	-	-	-	4	0.67	2	0.66	-	-	-	-	3	0.50	-	-
5	Cladosporium sp.	110	30.30	63	18.97	130	21.88	63	20.79	74	17.96	72	22.42	124	20.94	67	19.82
6	Cephalosporium	3	0.82	1	0.30	-	-	-	-	3	0.72	2	0.62	-	-	-	-

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7	Colletotrichum sp.	-	-	-	-	-	-	-	-	-	-	-	-	-	-	2	0.59
8	Corynispora sp.	-	-	-	-	-	-	-	-	-	-	-	-	4	0.67	-	-
9	Curvularia lanata	-	-	8	2.40	27	4.54	9	2.97	-	-	8	2.49	26	4.39	13	3.84
10	Dreshslera sp.	9	2.47	7	2.10	13	2.18	6	1.98	8	1.95	6	1.86	13	2.19	10	2.95
11	Fusarium sp.	24	6.61	5	1.50	16	2.69	9	2.97	25	6.06	8	2.49	19	3.20	8	2.36
12	Geotrichum sp.	4	1.10	2	0.60	3	0.50	1	0.33	5	1.21	2	0.31	-	-	-	-
13	Lasiodiplodia theobromae	23	6.33	6	1.80	6	1.01	6	1.98	4	0,97	7	2.18	7	1.18	6	1.77
14	Myrothecium sp.	3	0.82	2	0.60	-	-	-	-	5	1.21	1	0.31	-	-	-	-
15	Nigrospora sp.	4	1.10	2	0.60	3	0.50	-	-	4	0.97	1	0.31	4	0.67	2	0.59
16	Phoma sp.	8	2.20	-	-	11	1.85	2	0.66	10	2.42	2	0.62	11	1.85	5	1.47
17	Penicillium sp.	82	22.58	66	19.87	145	24.41	80	26.40	80	19.41	80	24.92	153	25.84	88	26.03
18	Pestalotia sp.	4	1.10	-	-	1	0.16	-	-	2	0.48	1	0.31	-	-	-	-
19	Pullularia sp.	-	-	-	-	3	0.50	-	-	-	-	-	-	2	0.33	1	0.29
20	Rhizopus sp.	20	5.50	4	1.20	9	1.55	9	2.97	24	5.82	5	1.55	12	2.02	7	2.07
21	Stachybotrys sp.	-	-	-	-	-	-	-	-	-	-	-	-	1	0.16	1	0.29
22	Trichoderma sp.	5	1.37	1	0.30	-	-	-	-	5	1.21	1	0.31	-	-	-	-
23	Torulla sp.	-	-	-	-	-	-	-	-	-	-	-	-	3	0.50	-	-
24	Trichothecium sp.	3	082	1	0.30	3	0.50	-	-	4	0.97	-	-	4	0.67	2	0,59
Total						569		292		335		323		571		325	

Table – 2. Enumeration of fungal propagules per 100 cm² of exposed area at fruit & vegetable market, Kolar & Chinthamani during the year 2011.

Sl. No	Fungal Types	Kolar Taluk								Chinthamani Taluk							
		Fruit market				Vegetable market				Fruit market				Vegetable market			
		Total colonies		Fungal / 100 cm²		Total colonies		Fungal / 100 cm²		Total colonies		Fungal / 100 cm²		Total colonies		Fungal / 100 cm²	
		In	Out	In	Out	In	Out	In	Out	In	Out	In	Out	In	Out	In	Out
1	Aspergillus sp.	112	64	22.01	25.16	162	81	31.84	31.84	92	76	18.08	29.88	147	91	28.8	35.77
2	Alternaria sp.	21	25	4.12	9.82	33	24	6.48	9.43	23	25	4.52	9.8	34	22	6.68	8.64
3	Botrytis sp.	6	2	1.17	0.78	-	-	-	-	9	2	1.76	0.78	-	-	-	-

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4	Candida sp.	-	-	-	-	4	2	0.78	0.78	-	-	-	-	3	-	0.58	-
5	Cladosporium sp.	110	63	21.62	24.76	130	63	25.55	24.76	74	72	14.54	28.30	124	67	24.37	26.34
6	Cephalosporium	3	1	0.58	0.39	-	-	-	-	3	2	0.58	0.78	-	-	-	-
7	Colletotrichum sp.	-	-	-	-	-	-	-	-	-	-	-	-	-	2	-	0.78
8	Corynispora sp.	-	-	-	-	-	-	-	-	-	-	-	-	4	-	0.78	-
9	Curvularia lanata	-	8	-	3.14	27	9	5.30	3.53	-	8	-	3.14	26	13	5.11	5.11
10	Dreshslera sp.	9	7	1.76	2.75	13	6	2.55	2.35	8	6	1.57	2.35	13	10	2.55	3.93
11	Fusarium sp.	24	5	4.17	1.97	16	9	3.14	3.53	25	8	4.91	3.14	19	8	3.73	3.14
12	Geotrichum sp.	4	2	0.78	0.78	3	1	0.58	0.39	5	2	0.98	0.78	-	-	-	-
13	Lasiodiplodia theobromae	23	6	4.52	2.34	6	6	1.17	2.35	4	7	5.30	2.75	7	6	1.37	2.35
14	Myrothecium sp.	3	2	0.58	0.78	-	-	-	-	5	1	0.98	0.39	-	-	-	-
15	Nigrospora sp.	4	2	0.78	0.78	3	-	0.58	-	4	1	0.78	0.39	4	2	0.78	0.78
16	Phoma sp.	8	-	1.57	-	11	2	2.16	0.78	10	2	1.96	0.78	11	5	2.16	1.96
17	Penicillium sp.	82	66	16.12	25.94	145	80	28.50	31.45	80	80	15.72	31.45	153	88	30.07	34.59
18	Pestalotia sp.	4	-	0.78	-	1	-	0.19	-	2	1	0.39	0.39	-	-	-	-
19	Pullularia sp.	-	-	-	-	3	-	0.58	-	-	-	-	-	2	1	0.39	0.39
20	Rhizopus sp.	20	4	3.93	1.57	9	9	1.76	3.53	24	5	4.71	1.96	12	7	2.35	2.75
21	Stachybotrys sp.	-	-	-	-	-	-	-	-	-	-	-	-	1	1	0.19	0.39
22	Trichoderma sp.	5	1	0.98	0.39	-	-	-	-	5	1	0.98	0.39	-	-	-	-
23	Torulla sp.	-	-	-	-	-	-	-	-	-	-	-	-	3	-	0.58	-
24	Trichothecium sp.	3	1	0.58	0.39	3	-	0.58	-	4	-	0.78	-	4	2	0.78	0.78

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