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Aero-Microbial Assessment with Reference to Different Seasons in A Vegetable Market

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ABSTRACT

Study on airborne concentrations of bacteria and fungi is important in improving exposure estimates and developing efficient control strategies to reduce health risk. This extramural study was therefore undertaken during 2011-12 and 2012-13 to determine the presence and seasonal distribution of the airborne microbes in the air of the vegetable market by using petri plate method. This study was aimed at understanding the distribution pattern of microbes in the air. The importance of estimation of quantity and types of airborne bacteria and fungi can be used as an index for nature of the environment, as well as an index they bear in relation to human health. The concentration of the microbes varied according to the location, altitude, season of year, condition of the surrounding area and climatic conditions. This resulted in a total of 12 identified sps of which Aspergillus, and Penicillium were dominant and in selected bacteria Staphylococcus spp and Klebsialla spp were dominant. The media used for the study of fungi was Sabaroud Chloramphenecol Agar (SCA). In the sampling bacterial counts were influenced by temperature, while aerosol fungi correlated to temperature and relative humidity. Taking into consideration the entire assay the concentration of the fungi was considerably high in the winter and rainy season where as the bacterial concentration was remarkably high in the summer season.

Key words: *Fungi, Bacteria, Petri plate method, Vegetable market*

INTRODUCTION

The air contains a complex mixture of microorganisms, microorganism fragments, and byproducts such as molds, bacteria, endotoxins, mycotoxins, and volatile microbial organic compounds. Exposure to these microbial fragments and metabolites may result in adverse health effects, as they can be toxic, allergenic, and infectious[1]. Airborne microorganisms are considered as a key factor and as an indicator of the level of air pollution. Microorganisms, particularly airborne fungi and bacteria, have been shown to be a health risk and can cause diseases such as pneumonia, asthma, rhinitis (e.g., cold, hay fever), respiratory infection[2,3] and sick building syndrome[4,5,6].

The market is crowded with workers, customers, sellers, tourists, especially foreign visitors in weekend and holidays. It renders a favourable environment for the proliferation of microorganisms and the incidental elevation of airborne microorganisms and is also considered as a source of aerial disease transmission. The main aim of this work was to determine the microbiological content of the aerial ambient in the vegetable market of Davanagere. To estimate a hazard of microbiological air pollution a number of fungi and various groups of bacteria indoors should be determined, as precisely as possible. In this study the level of microbial contamination in a vegetable market was estimated using petri plate method.

MATERIAL AND METHODS

Sampling site

A vegetable market at the heart of the city was selected for the purpose of sampling. There was lot of movement of the people and the vehicles in the morning and it subsided gradually as the day progressed. The vegetable market comprised of several trees that provided shade to the vegetable vendors. The vendors sold vegetables either being seated in the shops or just sitting on the ground next to the roads. The vegetable market measured around 400 X 150 mts.

Sampling

To analyze the fungi, air samples were collected at six representative sites. At the entrance of the market, Near the vegetable shops, two sites near the vendors where there was lot of man movement, the places where

there was loading and unloading of vegetables and at the crossroads in the vegetable market. Petri plates of size 90mm with fungal media were exposed for ten minutes. The petri plates were placed above two feet from the ground level on the chairs. Sampling was carried out twice a month for a period of two years. Sampling was conducted in the morning between 10 to 11am.

Isolation and Identification of Fungi

For the isolation of the fungi Sabouraud Dextrose Agar (SDA) with 10mg/l chloramphenecol was used. After the sampling SDA plates were incubated at 25°C up to five days. With the use of Lactophenol blue solution a wet mount preparation of the fungi was prepared and was observed microscopically. Identification of the same was based mainly on the appearance of the colony, microscopic examination of the spore and the hyphal characteristics.

Isolation and identification of bacteria.

The samples were used for the enumeration and isolation of the air borne Bacteria. For the quantitative isolation of the bacteria Soybean Casein Digest Agar (SCDA) was used. For selective or differential analysis of certain dominant nosocomial infecting bacteria HiCrome UTI (urinary tract infection) agar[7] and HiCrome ECC (Escherichia coli & coliform) agar media[8] were used. Sampled plates were incubated at 37°C ± 1°C for 24-48 hours. For the better identification on chromogenic media. Identification was based mainly on formation of chrome by the colony on differential agar, staining and by biochemical methods.

RESULTS AND DISCUSSION

Fig.1 Concentration of fungi during 2011-2013
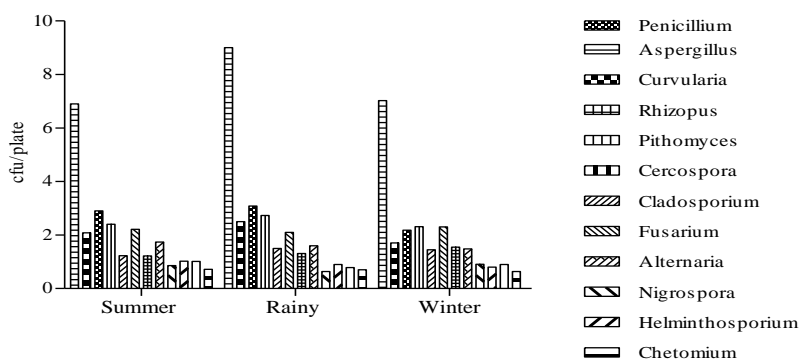
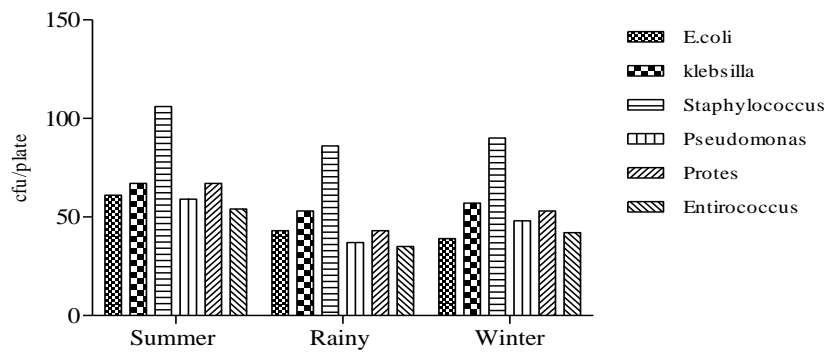**Fig.2 Concentration of bacteria during 2011-2013**

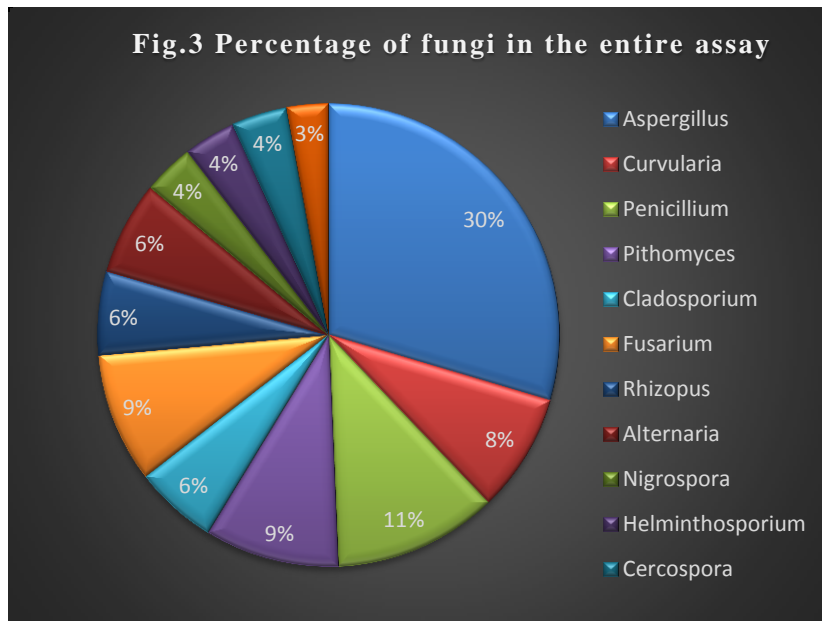Fig.3 Percentage of fungi in the entire assay
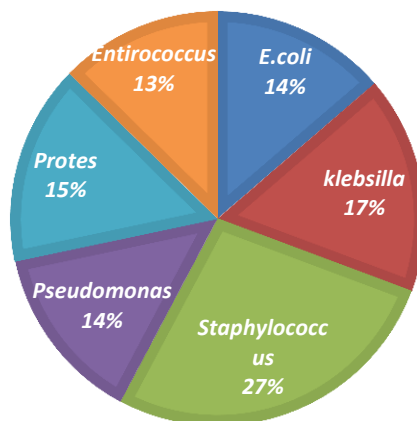
Fig.4 percentage of pathogens in the entire assay

Table 1: The fungal concentration /plate in the various seasons

	Summer		Rainy		Winter	
Organisms	**2011-12**	**2012-13**	**2011-12**	**2012-13**	**2011-12**	**2012-13**
Aspergillus spp	6.3	7.6	6.9	9.5	6.6	7.4
Curvularia spp	1.4	2.7	2.0	3.0	1.4	1.9
Penicillium spp	2.7	3.7	3.2	3.6	1.9	2.4
Pithomyces spp	1.8	2.3	2.0	3.1	2.1	2.5
Cladosporium spp	1	1.4	1.2	1.8	1.1	1.7
Fusarium spp	1.8	2.6	2.2	2.2	2.1	2.5
Rhizopus spp	1	1.5	1.2	1.6	1.3	1.7
Alternaria spp	1.2	2.2	1.7	1.8	1.4	1.5
Nigrospora spp	0.7	1.0	0.8	0.8	0.7	1.0
Helminthosporium spp	0.8	1.2	1.0	1.0	0.6	0.8
Cercospora spp	1	0.9	0.9	0.8	0.9	1.0
Chetomium spp	0.7	0.7	0.7	0.7	0.4	0.8

Table 2: The bacterial concentration /plate in the various seasons

Organisms	Summer		Rainy		Winter	
	2011-12	**2012-13**	**2011-12**	**2012-13**	**2011-12**	**2012-13**
Escherichia coli	69.5	52.5	44.25	41.25	45	32
Klebsilla spp	81.25	52.5	63.5	41.75	61.75	51.5
Staphylococcus spp	120.5	90.5	77.25	93.75	78	102.5
Pseudomonas spp	69.5	49.25	44.5	29.75	51	44.75
Protes spp	89	44.5	46.75	39.5	61	44
Entirococcus spp	64.5	43.75	36.5	33.75	42.25	41.75

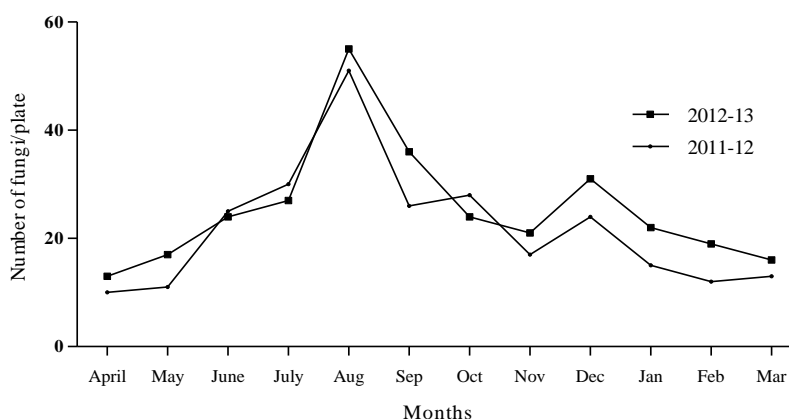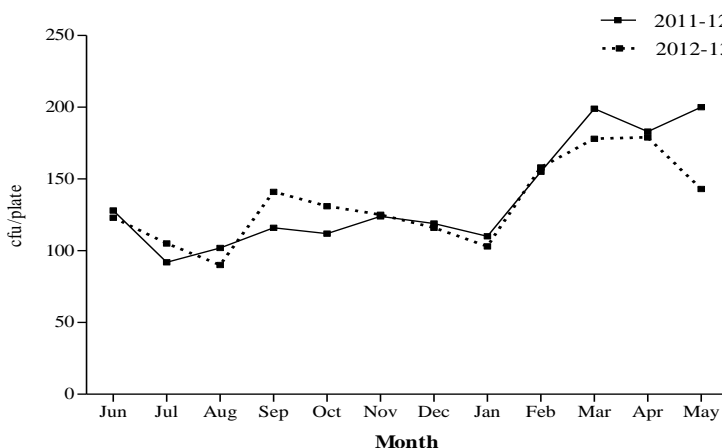**Fig.5 Comparative analysis of fungi in two years**

Fig.6 Comparative analysis of bacteria in two years

Despite the fact that atmospheric air does not favour growth of microorganisms due to lack of nutrients, the microorganisms are present in aerosol form, suspended in the air. The basic sources of microbes are soil, water, animals and humans. The bioaerosol consists of different types of microorganisms usually stuck to the particles of dust or suspended in tiny drops of water. Among them pathogenic viruses, bacteria and fungi, capable of causing human allergies and skin disease are present. The survival time of microorganisms in bioaerosol decreases at low contents of humidity and high UV radiation. Therefore, the number of microorganisms in the air fluctuates during the year. The place of our study, Davanagere experiences scanty rain fall in the months of July, August and September. Winter sets in the month of November and reaches up to January. March, April, and May will experience peak of summer season. Environmental conditions such as relative humidity (RH), temperature and wind velocity exert significant effect on the type of population and amount of microorganisms in the air[9,10,11]. Almost all airborne fungi isolated grew in filamentous forms and gave rise to characteristic colonies on Sabouraud plus chloramphenicol solid medium. The common fungi obtained during the sampling were *Aspergillus* spp*, Curvularia* spp*, Pithomyces* spp*, Alternaria* spp*, Penicillium* spp*, Rhizopus* spp*, Nigrospora* spp*, Fusarium* spp*, Mucor* spp*, Cladosporium* spp, Chaetomium spp, *Cercospora* spp and *Helminthosporium. Aspergillus* was found to be 30%, *Penicillium* 11%, *Pithomyces* 9%, *Fusarium* 9%, *Curvularia* 8%, *Alternaria* 6%, *Rhizopus* 5%, *Cladosporium* 6% and *Nigrospora* 4%, *Helminthosporium* 4%, *Chaetomium* 3%. and *Cercospora* 4% respectively. When it comes to the concentration of the fungi there was significant variation in the quantitative and the qualitative analysis. The fungi were quantitatively high during the Rainy (June-September) and the winter (December) season and comparatively less in the summer (March-May) season. This great abundance of fungi in different environments is due to ease of

dispersion of fungal spores in the air in both indoor and outdoor environments. *Aspergillus* and *Penicillium* produce mycotoxins such as aflatoxins, secalonic acid, zearalenone and tricothecenes that may affect the immunological response of lung tissues or cause other hazards to human health. *Aspergillus* spp and *Penicillium* spp are said to pose potential threats to the inmates being implicated in allergic disease and induced acute intoxication and many adverse effects to human health as carcinogenic, mutagenic, teratogenic, hormonal, hemorrhagic, immunotoxic, nephrotoxic, hepatotoxic, dermatoxic, neurotoxic, antibiotic, hematological changes, releasers of interleukins, and lipid peroxidation[12,13,14]. Many activities like traffic, constructions and people gathering in urban areas contribute largely to outdoor microbial load. The concentration of airborne microorganisms showed topological, geographical, diurnal and seasonal variations. Airborne microbial quantity and quality can vary with time of the day, year and location. When it comes to the concentration of the fungi there was significant variation in the quantitative and the qualitative analysis. The fungi were quantitatively high during the Rainy (June-September) and the Winter (December) season and comparatively less in the Summer (March-May) season.The concentration of the bacteria during the entire assay showed that they grew exorbitantly in the month of May that is in summer and the lowest was recorded in the month of January which is to some extent winter in the sampled city. Moderate temperature, moderate humidity and overly rainfall were associated with lowest incidence of bacterial flora Selected pathogens like *E. coli, Klebsialla* spp, *Pseudomonas* spp, *Salmonella* spp, *Staphylococcus* spp, *Proteus* spp, *Entirococcus* spp were found in the vegetable market. The percentage of bacterial pathogens varied from 27% to 13% in which Staphylococcus spp 27%,Klebsiella Sp 17%, Proteus Spp 15%, Escheschia coli sp 14%, Pseudomonas sp 14% and Enterococcus sp 13%. *Staphylococcus* spp being the dominant in the garden is a

commensal microorganism can cause opportunistic infections when host resistance is compromised, especially when a primary infection such as influenza is present. Since it exists ubiquitously mortality rate is high and it is responsible for many respiratory tract, digestive system, post operative infections, urinary tract and skin disorders with multi antibiotic resistance[15]. The presence of gram negative bacteria may increase health risk because they posses strong allergenic and endotoxic effects, fever, malaise and decreased pulmonary function[16].

CONCLUSION

Concentration of airborne microbes during the sampling period shows variability mostly depending on seasonal, climatic and geographic conditions of the particular area. The quantitative variations of the microbes was greatly influenced by temperature changes and solar radiation. Monitoring of airborne fungi can be helpful in prediction of their qualitative and quantitative variations depending on meteorological, geographical and seasonal climatic factors, which is of great importance for prevention of fungal and bacterial allergic diseases. It is important to know the distribution pattern of live bioaerosols at different sites in the urban environment. Therefore, to evaluate the potential for microbial air pollution and other associated risks.

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