

## Original Article

### A STUDY OF AEROALLERGENS IN AN AREA OF VISAKHAPATNAM

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#### Abstract

Aeroallergens are air borne microorganisms that include bacteria, fungi, pollen and dander. These become health hazard to those exposed routinely. People exposed to aeroallergens suffer from respiratory diseases like asthma, acute bronchitis and aspergillosis. A study was conducted in five different locations of Kancharapalem area of Visakhapatnam with different environmental conditions. Twenty five fungal species and eight bacterial species were present in the present study. Bacteria were present in the order of  $7.3 \times 10^4$  to  $4.5 \times 10^6$  during monsoon season and fungi during winter season showing  $7.5 \times 10^4$  to  $5.6 \times 10^6$ . Many fungal species were present in which *Aspergillus* were dominating. Similarly bacteria like *E.coli*, *Staphylococcus* and *Pseudomonas* were found in the study area.

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**Key words:** Aeroallergens, fungi, aspergilliosis, health hazard, Kancharapalem, Visakhapatnam.

#### INTRODUCTION

The increase in population, transportation and industrial development has resulted in the release of all kinds of pollutants into the environment. These pollutants can cause short-term as well as long-term effects to the human beings.

Air pollutants are grouped into Particulate and Gaseous pollutants. Particulate matter can be major cause of respiratory allergies and pathogenic infections of the respiratory tract. Allergic sensitization of the intrathoracic airways (asthma) or lung parenchyma (hypersensitive pneumonitic) may be a major health problem and this is of concern in the long term for exposure to inhaled aeroallergens (Dutkiewicz.J).

Bacterial cells and cellular fragments, fungal spores and by-products of microbial metabolism, present as particulate liquid or volatile organic compounds may be components of aeroallergens (Stetzenbach.L.D).

Inhalation of non-infectious microorganisms and constituents can cause inflammation of respiratory system, while antigens and allergens may activate the immune system and cause allergic and immunotoxic effects (Malmberg.P).

#### 1.1 HEALTH EFFECTS DUE TO AEROALLERGENS

1.1.1 Particulate matter of bacteria and fungi are mainly non-infectious, but may exert adverse effects on respiratory tract of the exposed person causing allergic rhinitis.

1.1.2 Diseases like asthma or cystic fibrosis develop a chronic allergic reaction with cough. The lining bronchi and alveoli become inflamed severely reducing the capacity to inhale. Fungus like *Alternaria*, *Aspergillus* and *Cladosporium* cause such diseases.

1.1.3 Allergic Bronchopulmonary Aspergillosis (ABPA) mostly caused due to *Aspergillus* is a life threatening disease.

1.1.4 Immunotoxic disease caused by inflammation of small air way and the alveoli of the lung due to mycotoxins and endotoxins produced by fungus and bacteria. The symptoms of this disease resemble those of influenza with high temperature shivering, nasal congestion, irritation of throat, headache and cough.

Developed countries have agencies like ACGIH (American conference of governmental Industrial Hygienists), OSHA (Occupational Safety Health Administration) which give

Table1: Fungal species in 3 minute and 5 minutes.

Sl. No.	Fungal Species	Monsoon										Winter									
		1		2		3		4		5		1		2		3		4		5	
		3	5	3	5	3	5	3	5	3	5	3	5	3	5	3	5	3	5	3	5
1	<i>Alternaria alternata</i>	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+
2	<i>Alternaria solani</i>	-	-	-	+	-	+	-	+	-	+	+	+	+	+	+	+	+	+	+	+
3	<i>Aspergillus candidus</i>	-	-	-	-	-	+	-	-	-	+	-	-	+	+	-	-	-	-	-	+
4	<i>Aspergillus flavus</i>	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+
5	<i>Aspergillus fumigatus</i>	-	+	-	+	-	+	-	+	-	+	+	+	+	+	+	+	+	+	+	+
6	<i>Aspergillus parasiticus</i>	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+
7	<i>Aspergillus versicolor</i>	-	-	-	-	-	-	-	+	-	-	-	-	-	-	-	+	+	-	-	
8	<i>Botrytis sp.</i>	-	-	-	+	-	-	-	+	-	+	-	-	+	+	-	-	+	+	+	+
9	<i>Cercospora sp.</i>	-	+	-	-	-	-	-	-	-	-	+	+	-	-	-	-	-	-	+	+
10	<i>Cladosporium cladosporioides</i>	-	-	-	-	-	-	-	-	-	+	+	+	-	-	-	+	-	-	+	+
11	<i>Curvularia affinis</i>	-	-	-	-	-	-	-	-	-	+	-	+	+	+	-	+	-	-	-	+
12	<i>Curvularia lunata</i>	-	-	-	-	-	-	-	-	-	+	-	+	+	+	+	+	-	-	+	+
13	<i>Fusarium moniliforme</i>	-	+	-	+	-	-	-	-	-	+	+	+	+	+	-	+	-	+	+	+
14	<i>Fusarium solani</i>	-	+	-	+	-	-	-	-	-	+	+	+	+	+	-	+	-	+	+	+
15	<i>Helminthosporium sp.</i>	-	-	-	-	-	-	-	-	+	+	-	+	-	+	-	+	-	-	+	+
16	<i>Mortierella zonata</i>	-	-	-	-	-	-	-	-	-	-	-	-	+	+	-	+	-	-	-	+
17	<i>Mucor microsporus</i>	-	-	-	+	-	-	-	+	-	-	-	+	+	+	-	-	+	+	-	+
18	<i>Mucor racemosus</i>	-	-	-	+	-	-	-	+	-	-	-	+	+	+	-	-	+	+	-	+
19	<i>Penicillium sp</i>	-	+	-	-	-	+	-	-	-	+	+	+	+	+	+	+	-	-	-	+
20	<i>Rhizopus oryzae</i>	-	-	-	-	-	-	+	+	-	-	-	+	-	+	-	+	+	+	-	+
21	<i>Rhizopus stolonifera</i>	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+
22	<i>Stachybotrys</i>	-	-	-	-	-	-	-	-	-	-	-	+	-	-	-	+	-	-	-	+
23	<i>Trichothecium sp</i>	-	-	-	-	-	-	+	-	-	-	-	+	-	+	-	+	-	+	-	+
24	<i>Trichoderma sp</i>	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+
25	<i>Verticillium sp</i>	-	-	-	-	-	-	-	-	-	-	-	+	-	-	-	+	-	-	-	+

1. Vegetable market. 2. A cross road junction. 3. Fish market 4. Cereal market. 5. Slum area

Table:2 Bacterial species in 3 minute and 5 minutes.

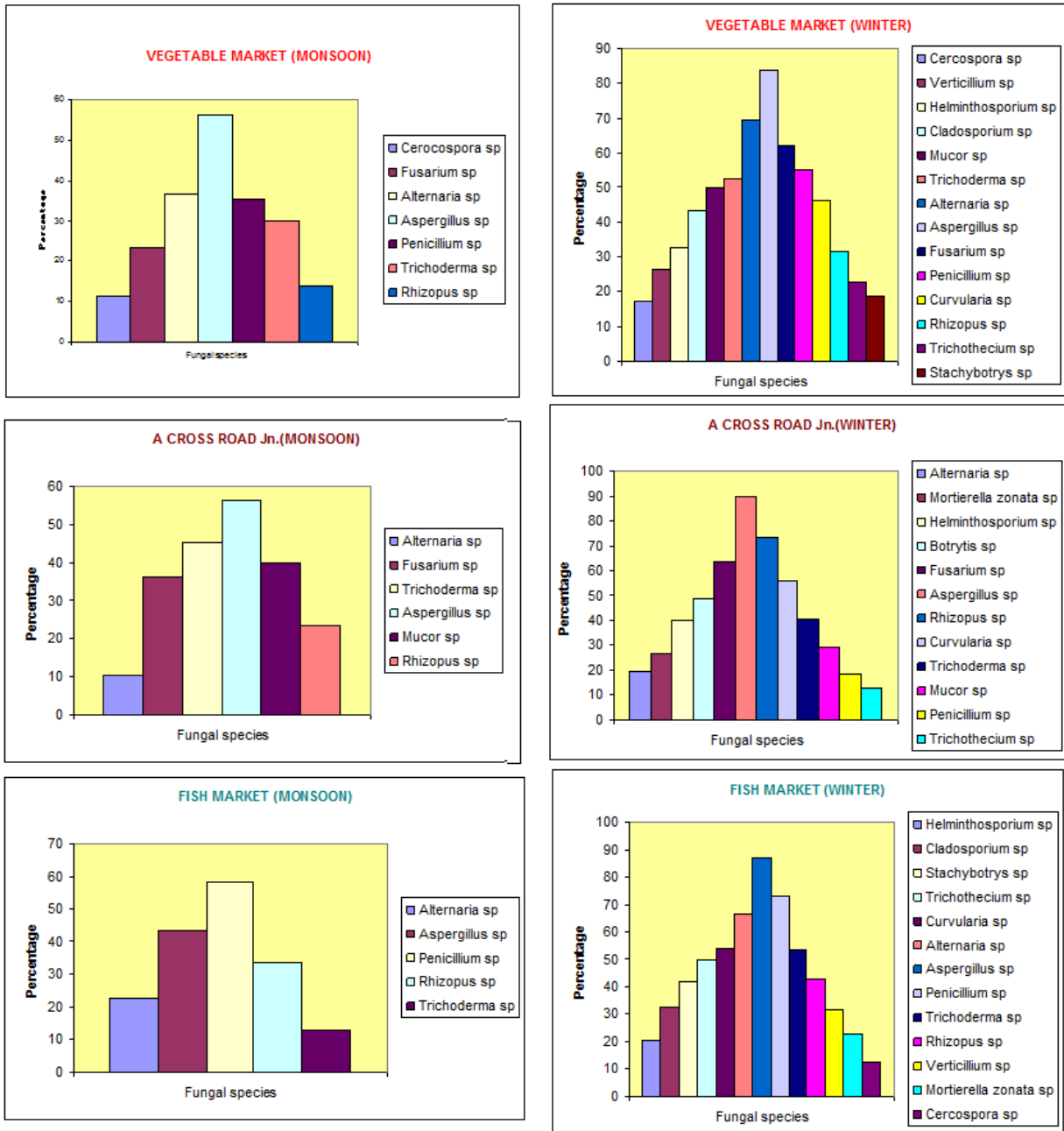
Sl. No.	Bacterial Species	Monsoon										Winter									
		1		2		3		4		5		1		2		3		4		5	
		3	5	3	5	3	5	3	5	3	5	3	5	3	5	3	5	3	5	3	5
1	<i>Bacillus subtilis</i>	+	+	+	+	+	+	-	+	+	+	-	+	-	+	-	+	-	-	-	+
2	<i>Enterobacter aerogenes</i>	+	+	+	+	+	+	-	-	+	+	-	+	-	+	-	-	-	+	-	+
3	<i>Escherichia coli</i>	+	+	+	+	+	+	+	+	+	+	-	+	-	+	-	+	-	-	-	+
4	<i>Proteus vulgaris</i>	+	+	+	+	+	+	+	+	+	+	-	+	-	+	-	+	-	+	-	+
5	<i>Pseudomonas sp.</i>	+	+	-	+	+	+	-	+	+	+	-	-	-	+	-	-	-	+	-	+
6	<i>Micrococcus sp</i>	-	+	-	+	+	+	-	-	+	+	-	-	-	+	-	+	-	-	-	+
7	<i>Staphylococcus aureus</i>	+	+	+	+	+	+	+	+	+	+	-	+	-	+	-	+	-	+	-	+
8	<i>Streptococcus lactis</i>	+	-	+	+	+	+	-	+	+	+	-	+	-	+	-	+	-	+	-	+

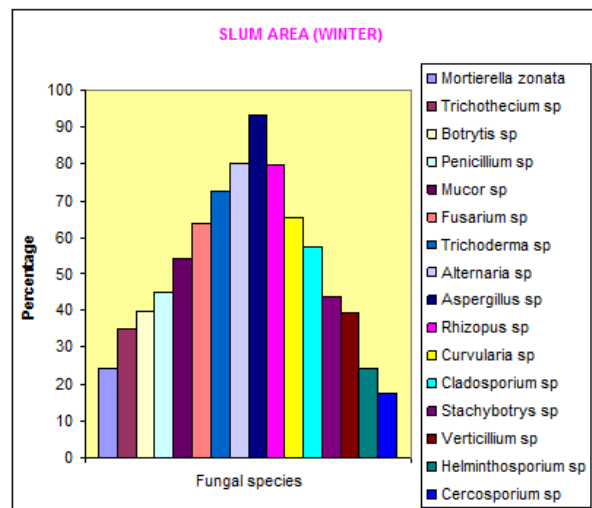
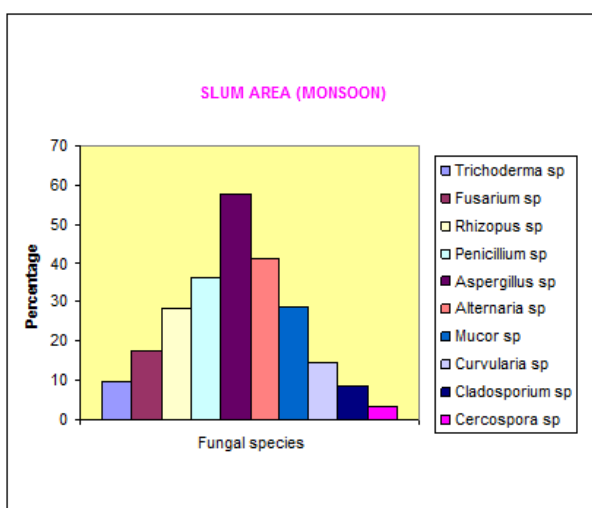
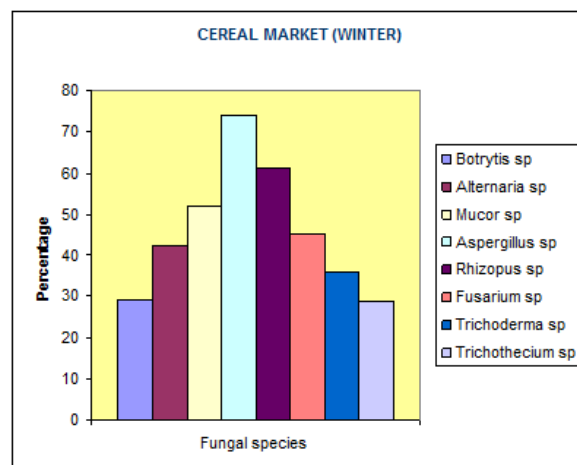
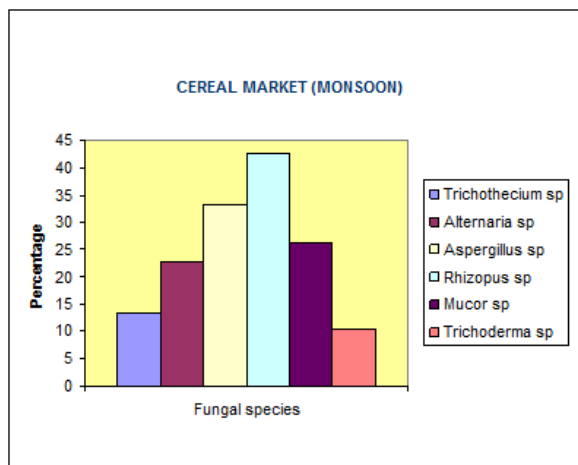
1. Vegetable market 2. A cross road junction. 3. Fish market 4. Cereal market. 5. Slum area

Table: 3 Colony forming units of Bacteria and Fungi

S. No.	Sampling area	Bacteria		Fungi	
		Monsoon	Winter	Monsoon	Winter
1	A Cross road junction	$7.3 \times 10^4$	$3.6 \times 10^3$	$4.2 \times 10^3$	$6.5 \times 10^5$
2	Vegetable market	$3.3 \times 10^6$	$2.6 \times 10^4$	$5.8 \times 10^3$	$7.5 \times 10^4$
3	Fish market	$4.5 \times 10^6$	$1.7 \times 10^5$	$3.7 \times 10^4$	$5.6 \times 10^5$
4	Cereal market	$5.6 \times 10^5$	$4.3 \times 10^3$	$2.7 \times 10^4$	$4.7 \times 10^5$
5	Slum area	$6 \times 10^6$	$6.5 \times 10^5$	$4.4 \times 10^4$	$5.6 \times 10^6$

GRAPHICAL REPRESENTATION OF FUNGI IN MONSOON AND WINTER SEASON IN DIFFERENT AREAS





health alerts periodically. Official statistics regarding occupational diseases in most of the industries exist in these countries. For an efficient diagnosis of the allergy and its effective treatment it is very important to know about the prevalence, seasonal and annual variation of aeroallergens of the area.

A study has therefore been undertaken to evaluate the bacterial and fungal population in the air in some selected area of the Kancharapalem and identify the potent aeroallergens which cause various types of allergies.

## MATERIAL AND METHODS

### 2.1 DIFFERENT SAMPLING SITES

A Kancharapalem area was selected in the city of Visakhapatnam due to heavy population residing in that area. In Kancharapalem five sampling sites were selected representing different environmental conditions for the present study.

1. Vegetable market, 2. A cross road junction, 3. Fish market, 4. Cereal market and 5. Slum area.

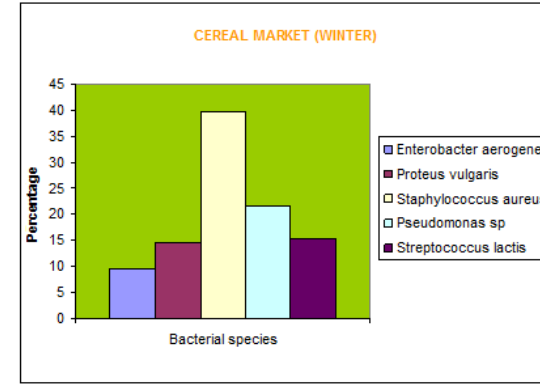
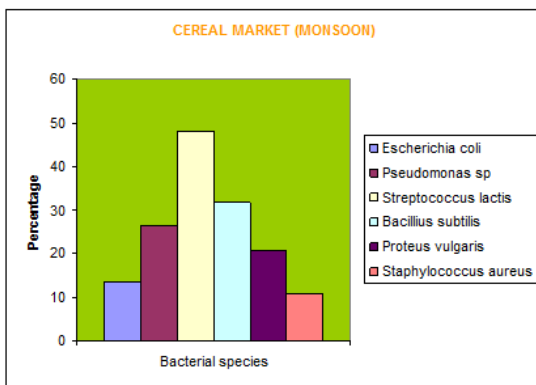
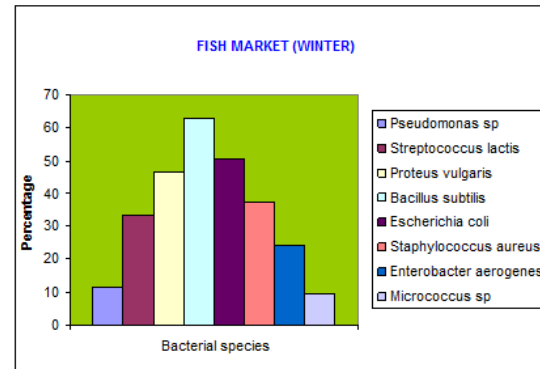
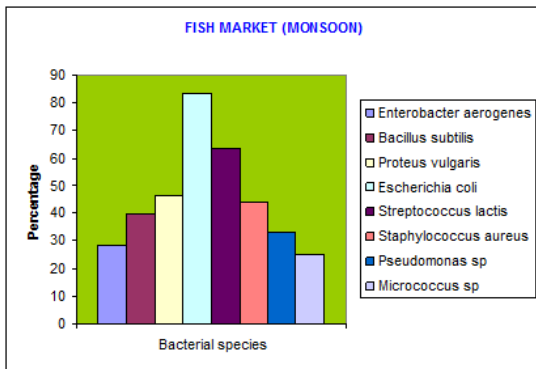
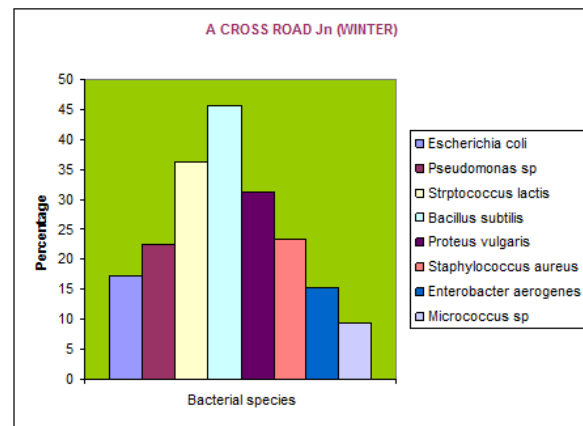
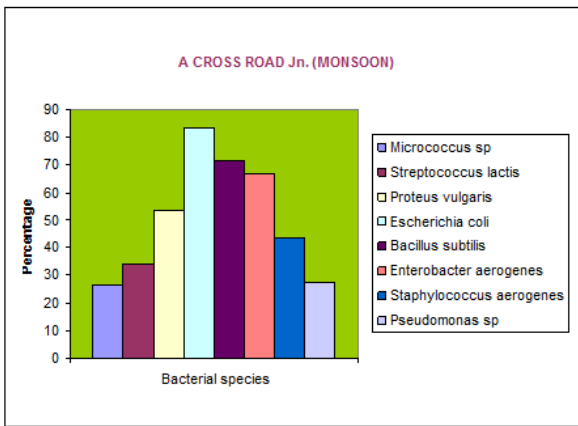
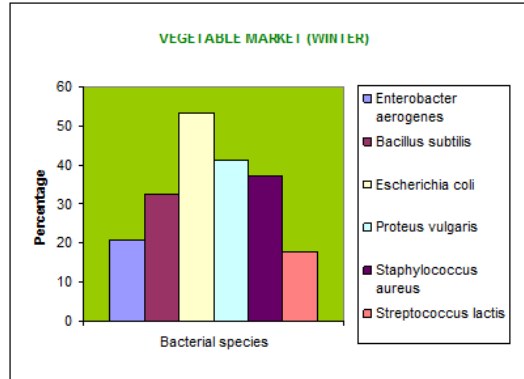
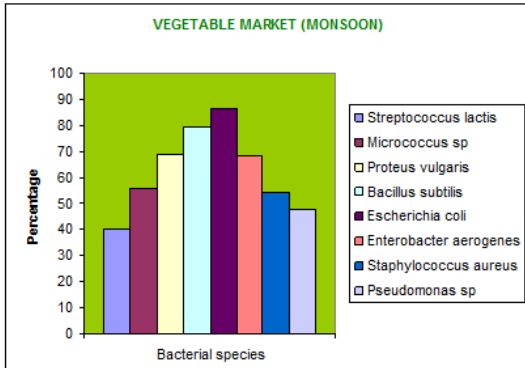
### 2.2 SAMPLING PROCEDURE

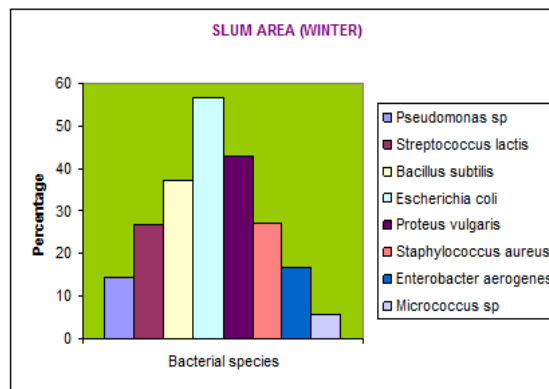
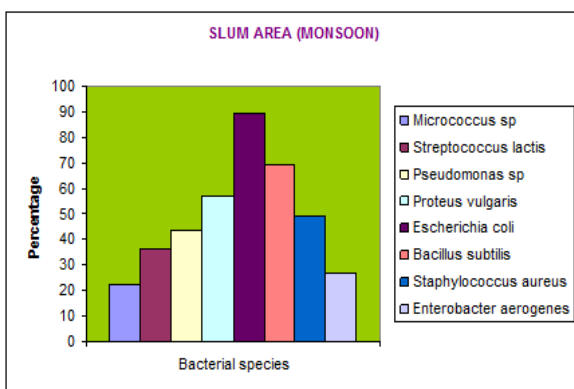
Air samples were collected twice daily for a period of eight months (July to February). For bacterial and fungal isolation gravity Petri-plate method was used. Keeping these plates 200cms above the ground. Samples were collected when high density population was floating between 8 a.m to 10 a.m and 6 p.m to 8 p.m.

### 2.3 ISOLATION OF FUNGI

Twenty Petri-plates containing Potato dextrose agar were exposed to air 200cms above the ground. This makes the spores to trap or blow into the Petri-plate. After exposing the open Petri-plates for 3minute and 5 minute these plates were closed and incubated for 5 days at 25°C. The fungi that developed after five days were examined under compound microscope after staining with cotton blue. The cultural and morphological characteristics of fungi were identified by the use of pictorial atlas of soil and seed fungi (Watnabe.T).

GRAPHICAL REPRESENTATION OF BACTERIA IN MONSOON AND WINTER IN DIFFERENT AREAS





## 2.4 ISOLATION OF BACTERIA

For bacterial isolation twenty brain heart infusion agar plates were opened to air for 3 minute and 5 minute and incubated at 37°C. Bacterial isolates were identified based on the morphological characters like colony, colour, texture followed by biochemical tests performed according to standard protocols. A total of 1,280 samples were collected from each sampling site(Williams and Wilkins Baltimore).

## RESULTS AND DISCUSSION

The fungi and bacteria present in the air in five different areas viz. A cross road junction, Vegetable market, Fish market, Cereal market and Slum area are *Alternaria alternata*, *A. solani*, *Aspergillus candidus*, *A. flavus*, *A.fumigatus*, *A.parasiticus*, *A.versicolor*, *Botrytis* sp, *Cercospora* sp, *Cladosporium cladosporioides*, *Curvularia affinis*, *C.lunata*, *Fusarium moniliforme*, *F.solani*, *Mucor microsporus*, *Penecillium* sp, *Rhizopus oryzae*, *R.stolonifera*, *Stachybotrys* sp, *Trichoderma* sp, *Trichothecium* sp, *Verticillium* sp, *Bacillus subtilis*, *Enterobacter aerogenes*, *Escherichia coli*, *Proteus vulgaris*, *Pseudomonas* sp, *Micrococcus* sp, *Staphylococcus aureus* and *Streptococcus lactis*.

The Petri-dish containing media were exposed for 3 minute and 5 minute at 200 cms to trap fungi and bacteria. Species of *Botrytis*, *Cercospora*, *Cladosporium*, *Curvularia*, *Fusarium*, *Helminthosporium*, *Mucor*, *Trichothecium* and *Verticillium* were not recorded in 3 minute time. The fungi and bacteria trapped at different timings are shown in table 1 and 2.

The most dominating fungi species in these areas are *Aspergillus flavus*, *Aspergillus parasiticus*, *Aspergillus fumigatus*, *Alternaria alternata*, *A.solani*, *Fusarium moniliforme*, *F. solani*, *Mucor microsporus* and *Penicillium* sp and bacterial species are *Bacillus subtilis*, *Enterobacter aerogenes*, *Escherichia coli*, *Proteus vulgaris*, *Pseudomonas* sp, *Staphylococcus aureus* and *Streptococcus lactis*.

The population of bacterial spores is high in all sampling sites compared to fungal spores. The range of

bacterial population varied from  $3.6 \times 10^3$  to  $6 \times 10^6$  cfu while fungi range from  $2.1 \times 10^4$  to  $6.5 \times 10^5$ . (Table: 3)

Dutkiewicz et.al reported bacteria as high as  $10^5$  cfu/m<sup>3</sup> in vegetable processing units. In our study bacterial spores were high representing  $3.3 \times 10^6$  cfu/m<sup>3</sup>. Highest bacterial count was recorded during monsoon season (July-September) compared to winter season (November-January). Shrivastava reported highest concentration of air borne bacteria in the month of July in similar environmental conditions.

Fungal species are dominating during winter season compared to monsoon season (Jo-Hyun Lee and Wan-Kuen Jo). In our present study this seasonal variation was observed in all sampling sites. *Aspergillus*, *Cladosporium* was abundant in winter season and can cause respiratory diseases (Alvarado.C.S.et.al and Li Li). In our study these two genera are commonly reported in all sampling sites.

Aspergillosis was noticed in the farm workers exposed to *Aspergillus flavus* and *Aspergillus fumigates* (Mulhausen J.R.et.al). Studies revealed that these two species were present in all the sampling sites posing a potential risk of Aspergillosis.

In the present study many other fungal species were observed in the air which cause respiratory diseases to the people exposed to air. These are *Alternaria*, *Cladosporium*, *Curvularia* and *Trichoderma* (Mohammed H.et.al).

*Bacillus subtilis*, *E.coli* and *Proteus vulgaris* were predominant micro flora in slum area. Most of the bacterial population was high in slum area during monsoon and winter season due to improper hygienic conditions.

*Bacillus subtilis*, *Proteus vulgaris*, *Pseudomonas* sp and *Staphylococcus aureus* were dominant in the fish and cereal market. In our study these were seen high in these sampling areas also.

Kancharapalem area has high population density in Visakhapatnam city. Here high density of bacterial and fungal spores were identified with a range of  $6 \times 10^6$  for bacteria and  $5.2 \times 10^6$  for fungi.

## CONCLUSION

Studies to be carried throughout the year to assess the biological load in air and to take some preventive steps like wearing protective masks to reduce health hazards. This study will also enable local physicians to take the results into consideration during diagnosis and plan their treatment.

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