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ATMOSPHERIC STUDIES OF FUNGAL BIOAEROSOLS IN THE MARKET AREA OF NAWAPARA (RAJIM), DISTRICT- RAIPUR (CHATTISGARH)

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ABSTRACT

Bioaerosols are airborne particles, large molecule or volatile compounds that are ubiquitous in the environment. Fungi are heterogeneous group of organisms belonging to the group of eukaryotes, are the major part of the microbial diversity. Most of them cause disease in plants, animals and humans beings, and are also responsible for deterioration of fruits, vegetables and other food stuffs, when present in more than reasonable limits. Air is not a suitable medium for fungal growth due to lack of nutrients, but it is a suitable medium for dissemination of fungal spores from one place to another. Market area is always densely populated area where people of different area gather. Hence the present study is undertaken to analyze the atmospheric studies of fungal bioaerosols in the market area of Nawapara (Rajim). It was carried out from July 2008 to June 2009 with the help of Gravity petriplates method. During present investigation 728 colonies of 67 fungal sp. were identified maximum 51 fungal sp. were observed in the month of December, while minimum 09 fungal sp. were observed in May. Out of total fungal flora the percentage contributions of different classes were as follows, Zygomycotina (2.60), Ascomycotina (1.09), Anamorphic fungi (92.85) and Mycelia sterilia (3.43). Out of total fungal population *Cladosporium cladosporiodes* (15.10) was most dominated were as *Aspergillus niger* (12.08), *A. flavus* (10.43), *A. versicolar* (5.49), *Cladosporium oxysporum* (3.15) and *Curvularia clavata* (2.47) were dominant fungal bioaerosols.

KEYWORDS: Bioaerosols, Aerobiology, Nawapara (Rajim)

The American Conference of Governmental Industrial Hygienists (ACGIH) defines bioaerosols as air borne particles, large molecule or volatile compounds that are living contain living organism or were released from living organisms. Dust, Mites, Molds, Fungi, Spores, Pollen, Bacteria, Viruses, Algae, Protozoa's, gases, vapors, fragment of plant materials, and human and pet dander (skin which has been shed) are some example. Bioaerosols are everywhere in the environment and pose no problems in most cases when its quantity and the various types are kept within reasonable limits. However some bioaerosols, when breathed in, can cause diseases including pneumonia, asthma, rhinitis (cold hay fever) and respiratory infection. Bioaerosols may also cause allergic reaction on the skin. However, in agriculture many of the crops are affected by the airborne pathogenic bioaerosols. Airborne fungal spores contribute a major share of bioaerosols and investigations are essential to understand their distribution, ecology and biodeterioration, to forecast plant diseases and to detect allergies and skin diseases. The most significant environmental factors influencing the viability of microorganisms are temperature, relative humidity, and wind velocity. The study of air borne microorganisms their identity, behavior, movement, survival, dispersion, deposition and impact of human beings, animal and plant is referred to the branch of science called Aerobiology. Fungi are heterogeneous group of organisms belonging to the group of eukaryotes. They are ubiquitous in indoor and outdoor environments. Fungi are the major part of microbial diversity. Nawapara (Rajim) is a place of historical importance. Market area is always densely populated area where people of different area gather. Hence the present study is undertaken to analyze the atmospheric studies of fungal bioaerosols in the market area of Nawapara (Rajim).

MATERIALS AND METHODS

Bioaerosols are ubiquitous and present in various fields of environment. In the present study entitled "Atmospheric studies of fungal bioaerosols in the Market area of Nawapara (Rajim), District- Raipur" by using gravity petriplates method (containing PDA medium) during July 2008 to June 2009.

Raipur is capital of newly formed Chhattisgarh state. It is geographically located approximately in central part of India at 21- 14' North latitude and 81- 37' in East latitude, situated at a height of 298.60 meters above mean sea level.

Nawapara (Rajim), District-Raipur is located 45 kilometers southeast of Raipur on the bank of the Mahanadi river, this was ones an important urban center of Chhattisgarh state. It is geographically located at 20^{o} 58' North latitude and 81^{0} 50' in East latitude, situated at height of 297.80 meters above the sea level and situated in the middle east of Chhattisgarh. This area is known as the "Prayag" of Chhattisgarh because it is

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situated at the meeting point of the Mahanadi, Pairy and Sondur rivers. An ancient Rajivlochan temple and Lord Kuleshwar temple are also here. Cultural and heritage department of Chhattisgarh organize here Kumbh every year. For the survey of fungal bioaerosols sterilized petriplates containing PDA media were exposed for 5-10 minutes at Market area of Nawapara (Rajim) Raipur. Then the petriplates were brought into the laboratory and incubated at 26 ± 1˚c for 4-6 days. After incubation period, number of fungal colony were be counted and identified with the help of available literature.

RESULTS AND DISCUSSION

During present investigation 67 fungal sp. of 728 colonies were recorded. Monthly variation and percentage contribution of the fungal sp. were calculated (Table-1). Out of total fungal bioaerosols Zygomycotina (2.60), Ascomycotina (1.09), Anamorphic fungi (92.85) and Mycelia sterilia white (2.19%) were recorded Anamorphic fungi were highest in number.

During the study *Aspergillus flavus, A. niger, Cladosporium cladosporiodes,* were most frequent fungi were as *Alternaria alternata, Curvularia clavata, Acremonium strictum, Alternaria citri, Aspergillus fumigatus, A. luchuensis, A. versicolar, Acremonium kiliense, Aspergillus fumigatus, A. oryzae, A. sydowii, Cladosporium oxysporum, Fusarium solanii, Paecilomyces variotii, Penicillium chrysogenum* were moderate frequent fungi. On the contrary *Chaetomium* sp., *Alternaria radicinia, Alternaria* sp., *Aspergillus chevalieri* var. *intermedius, Aspergillus japonicus, Trichoderma* sp. showed least frequent fungi. The result obtained in the present study are in agreement with several scientist Verma and Khare (1988) reported that the *Aspergillus, Cladosporium* and other fungal species were most dominated throughout the study period. Sateesh and Rao (1994) are also reported *Cladosporium, Curvularia* and fungal fragments are found all through the year in Tiruchirapali. Aspergillus was found to be most predominant in the atmosphere of Raipur (Tiwari and Sahu, 1998; Sahu, 1998 and Jadhav and Tiwari, 1994).Tiwari *et. al*. (2006) has also reported *Aspergillus, Alternaria* and *Cladosporium* were most frequent in their study. Arora and Jain (2003) reported *Cladosporium, Aspergillus* and *Penicillium* are most frequent fungi from Bikaner. Singh (2006) reported that the *Aspergillus niger* and *Cladosporium* sp. are the most frequent fungi similar result have also been reported by Kasperzyk and Worek, 2006; Kunjam, 2007; Lall, 2008; Tiwari and Saluja, 2009; Giri and Sawane , 2010; Kumari, *et. al*., 2011; Pyrri and Kapsanaki-Gotsi, 2012,Ghosal and Bhattacharya (2012), Raveesha (2015), Pawar and Rane (2015).

The result also indicate that maximum percentage contribution of *Cladosporium cladosporiodes* (15.10%) *Aspergillus niger* (12.08%), *A. flavus* (10.43%), *A. versicolar* (5.49%), *Cladosporium oxysporum* (3.15%), *Curvularia clavata* (2.47%), Mycelia sterilia (White) (2.19%) and minimum percentage contribution of *Alternaria* sp. and *Chaetomium* sp. (0.13%). Maximum number of fungal sp. (51) were reported in the month of December while minimum number of fungal species (09) in the month of May. *Aspergillus flavus*, *A. niger* and *Cladosporium cladosporiodes* were present throughout the month. Certain fungi were present more than one month but not in all month like *Rhizopus oryzae, Alternaria alternata, Aspergillus fumigatus, Curvularia clavata, Nigrospora oryzae, Penicillium chrysogenum* and *P. notatum*. Some fungi were present only in particular month like *Alternaria brassicola* and *Chaetomium* sp. present only in November *Aspergillus speluneus, Alternaria crassa* present in December *Alternaria radicinia* and *Rhizopus stolonifer* present only in January and *Alternaria* sp. present only in March.

The dominance of *Cladosporium, Aspergillus, Curvularia* and *Alternaria* is an agreement with observation of several scientist *i.e.* Gupta *et. al.* (1960) at Jaipur, Agrawal *et. al*. (1969) at Delhi, Vishnumittre and Khandelwal (1973) at Lucknow, Chitaley and Bajaj (1973) at Nagpur, Tilak and Vishwe (1975) at Aurangabad, Rati and Ramalingam (1976) at Mysore, Jankibai and Suba Reddi (1981) at Visakhapatanam, Patil (1982) at Nagpur, Chaubal and Kotamire (1983) at Kolhapur, Verma and Khare (1987) at Jabalpur, Singh and Mishra (1988) at Gaya. Singh *et. al.* (1994) also reported *Aspergillus flavus* contributed (24.2%), followed by *Cladosporium* (38.8%) and *Alternaria* (7%) on hospitals environment of Delhi. Jadhav and Tiwari (1994), were also reported that the *Cladosporium, Aspergillus* and *Alternaria* are most abundant aeromycoflora of Ravan Village. *Cladosporium, Aspergillus* and *Alternaria* contributed major airspora are reported by several scientists in abroad *i.e.* Abdel–Hameed *et. al.* (2007) also reported that the *Alternaria* (24.26%), *Aspergillus* (19.2%), *Cladosporium* (14.5%) and *Penicillium* (11.43%) are maximum contributed and predominant fungal genera in the atmosphere of Giza, Egypt. Pyrri and Kapsanaki-Gotsi (2007) have reported a great number of species were recognized in the prevalent genera *Cladosporium, Aspergillus and Alternaria* in Athens, Greece. Similar result has also been reported by Sabariego *et. al.* (2007)

at Madrid Spain, Grinn-Gofron and Mika (2008) at Poland, Aydogdu and Asan, (2008) at Edrine City, Turkey, Safatov *et. al*. (2010) at Western Siberia and Mallo *et. al*. (2011) at La Plata, Argentina.

Table 1: Showing percentage frequency and percentage contribution of fungal bioaerosols of Nawapara (Rajim) Distt. Raipur from Jul 2008 to June 2009.

S.No.	Fungal species	Total No. of Fungal colonies	percentage frequency	percentage contribution
1	*Cunninghmella echinulata*	03	16.66	0.41
2	*Mucar racemosus*	02	16.66	0.27
3	*Rhizopus oryzae*	09	50.00	1.23
4	*Rhizopus stolonifer*	02	8.33	0.27
5	*Syncephalostrum racemosum*	03	16.66	0.41
6	*Chaetomium* sp.	01	8.33	0.13
7	*Emercella nidulans*	07	33.33	0.96
8	*Acremonium kiliense*	15	75.00	2.06
9	*A. strictum*	12	66.66	1.64
10	*Alternaria alternata*	13	66.66	1.78
11	*Alternaria brasscicola*	02	8.33	0.27
12	*Alternaria cheiranthi*	05	16.66	0.68
13	*Alternaria citri*	16	58.33	2.19
14	*Alternaria crassa*	02	8.33	0.27
15	*A. radicinia*	05	8.33	0.68
16	*Alternaria* sp.	01	8.33	0.13
17	*Aspergillus carneus*	06	41.66	0.82
18	*A. awamori*	05	25.00	0.68
19	*A. Chevalieri* var. *intermedius*	07	33.33	0.96
20	*A. flavus*	76	100.00	10.43
21	*A. fumigatus*	13	66.66	1.78
22	*A. japonicus*	06	25.00	0.82
23	*A. luchuensis*	10	58.33	1.37
24	*A. nidulans*	03	16.66	0.41
25	*A. niger*	88	100.00	12.08
26	*A. niveus*	04	25.00	0.54
27	*A. ochraceous*	09	41.66	1.23
28	*A. oryzae*	02	16.66	0.27
29	*A. parasiticus*	02	16.66	0.27
30	*A. speluneus*	01	8.33	0.13
31	*A. sydowii*	08	33.33	1.09
32	*A. tamarii*	06	33.33	0.82
33	*A. terreus*	08	33.33	1.09
34	*A. versicolar*	40	83.33	5.49
35	*Cladosporium cladosporiodes*	110	100.00	15.10
36	*C. herbarum*	06	33.33	0.82
37	*C. oxysporum*	23	50.00	3.15
38	*Cladosporium* sp.	03	25.00	0.41
39	*Curvularia clavata*	18	66.66	2.47
40	*C. lunata*	13	50.00	1.78
41	*C. senegalensis*	05	25.00	0.68
42	*Drechslera hawaiiensis*	04	25.00	0.54
43	*Drechslera* sp.	03	16.66	0.41
44	*Fusarium chlamydosporum*	08	33.33	1.09

45	*F. moniliforme*	08	25.00	1.09
46	*F. solanii*	09	41.66	1.23
47	*F. oxysporum*	08	33.33	1.09
48	*Microascus aff. M. Manginii*	05	25.00	0.68
49	*Microascus* sp.	04	16.66	0.54
50	*Monilia* sp.	04	16.66	0.54
51	*Myrothecium aff. M. jollymanii*	06	25.00	0.82
52	*Myrothecium roridum*	03	16.66	0.41
53	*Nigrospora oryzae*	08	33.33	1.09
54	*Paecilomyces variotii*	11	50.00	1.51
55	*Penicillium chrysogenum*	08	41.66	1.09
56	*P.citrinum*	07	25.00	0.96
57	*P. notatum*	05	25.00	0.68
58	*P. rugulosum*	06	16.66	0.82
59	*Penicillium* sp.	06	25.00	0.82
60	*Periconia* sp.	02	16.66	0.27
61	*Phoma glomerata*	06	33.33	0.82
62	*P. sorghina*	03	16.66	0.41
63	*Scopulariopsis* sp.	04	16.66	0.54
64	*Trichoderma* sp.	03	16.66	0.41
65	*Trichurus spiralis*	02	16.66	0.27
66	Mycelia sterilia (white)	16	83.33	2.19
67	Mycelia sterilia (Grey black)	08	58.33	1.23

Table 2: Showing month wise and group wise total percentage contribution of fungal bioaerosols in the Market area of Nawapara (Rajim)

S. No.	Name of Fungal group	Rainy season				Winter season				Summer Season			
		Months				Months				Months			
		Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun
1	Zygomycotina	5.35	-	2.89	4.28	1.19	2.47	2.46	4.16	2.17	-	-	4.16
2	Ascomycotina	-	-	2.89	-	-	1.65	1.23	-	4.34	-	-	-
3	Anamorphic fungi	91.07	96.36	95.65	91.42	94.04	96.69	95.06	88.88	91.30	96.66	95.00	91.66
4	Mycelia sterilia	3.57	3.63	1.44	8.57	3.57	0.82	1.23	6.94	2.17	3.33	5.00	4.16
Grand total percentage contribution of fungal Sp.		**7.69**	**7.55**	**9.47**	**9.61**	**11.53**	**16.62**	**11.12**	**9.89**	**6.31**	**4.12**	**2.74**	**3.29**

Figure 1: Showing month wise percentage contribution of fungal bioaerosols

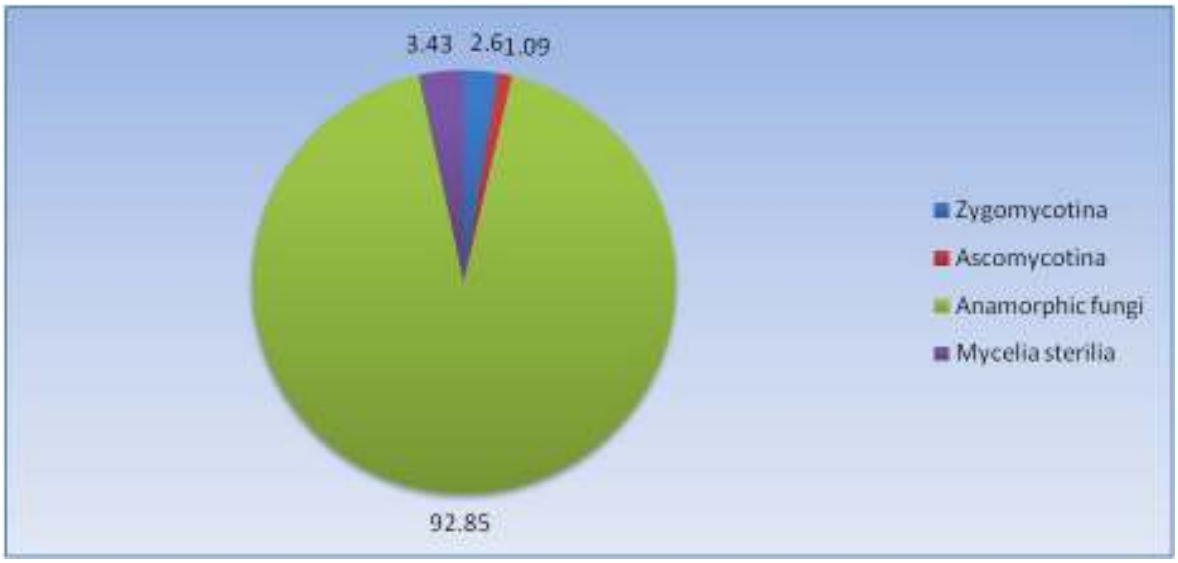

Figure 2: Showing total percentage contribution of fungal group of bioaerosols

Table 3: Showing class wise total fungal colonies distribution of bioaerosols in Market area of Nawapara (Rajim)

S. No.	Name of fungal group	Total no. of colonies	Percentage contribution
1	Zygomycotina	19	2.60
2	Ascomycotina	08	1.09
3	Anamorphic fungi	676	92.85
4	Mycelia sterilia	25	3.43

CONCLUSION

During investigation period it was observed that the Market area of Nawapara (Rajim) District-Raipur was never free from fungal bioaerosols throughout the month. In the present study fungal genera *Aspergillus, Alternaria, Cladosporium* and *Curvularia* were found in immense quantity. Our knowledge of these fungal genera would be beneficial in adopting necessary precautions to avoid fungal infection in human beings as well as plants.

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