International Journal of Science and Research (IJSR)
ISSN (Online): 2319-7064
Index Copernicus Value (2013): 6.14 | Impact Factor (2015): 6.391

Occurrence of Aeromycoflora in the Kitchen Environment of Jabalpur City

Ruchi Koshta[1], Akhilesh Ayachi[2]

Bioscience Department, Rani Durgawati University, Jabalpur (M.P.)-India

Abstract: ***Exposure to outdoor and indoor airborne inhalant mold allergens develops respiratory symptoms and airway diseases and allergies. Thus clean environment is of prime importance to reduce the fungal spore load in the air. This study was performed to analyze the distribution of kitchen indoor and outdoor air mycoflora in different residential houses of Zone VI of Jabalpur city. Samples were collected during Jan. 2014 to Dec. 2014 by using Andersons two stage sampler and viable fungal colonies were isolated and different fungal spores were identified from the indoor and outdoor air of the dwellings. During the study period a total of 30 fungal species belonging to 9 genera were observed. Penicillium notatum was most dominant types in all fungal forms followed by Alternaria tenius, Alternaria sp., Mucor sp.and Mucor racimosus was prevalent in both indoor and outdoor environment. Thus by increasing the ventilation rate can be helpful in improving the kitchen air quality.***

Keywords: Airborne, mycoflora, kitchen environment, outdoor

1. Introduction

A kitchen is a room or part of a room used for cooking and food preparation in a dwelling or in a commercial establishment. Fungi can spread anywhere in the kitchen. The contamination of indoor environment with the presence of micro organisms and other bioparticles are causes of major health problems. The species that are able to colonize indoor environment can utilize nutritional source available in indoor materials and moisture is the most important factor controlling fungal growth [1]. Mold grows at room temperature, so mold constantly thrive and related allergy flourishes in house. The airborne fungal spores will find an appropriate place to live and grow in kitchen because it contains adequate food and moisture [2], [3].

In this study, total fungal spores were obtained using Anderson two stage sampler. The sampling was performed inside and outside of houses of Zone VI for one year. The main objective of this study is to determine the qualitative and quantitative aspects of indoor and outdoor fungal load of Kitchen environment of Jabalpur and identification and preservation of fungal isolates and also to determine the relationship between indoor and outdoor aerofungi of study area.

2. Literature Survey

Ayachi et al. [4] reported human beings are greatly influenced by their surrounding environment. The environmental parameters are of importance as they determine the evolution and prevalence of allergenic pollutant such as microorganisms. Visible fungal (mold) growth has been linked with elevated *Aspergillus* and *Penicillium* concentrations [5] which are common indoors and contain species with known adverse effects on health. However, nonvisible mold growth concealed within wall cavities or building materials can also negatively affect indoor air quality [6].

Cetinkaya et al. [7] conducted to determine fungal spores in the indoor air of the houses in the city of Afyon, Western-Anatolia, Turkey. We investigated the seasonal properties of mould spores in 10 houses of Afyon over a period of one year. Viable moulds were recovered from all 10 houses. Twenty seven different moulds were isolated and identified from the indoor air of the houses. The most common genus was *Cladosporium* spp. (31.9%), followed by *Aspergillus* spp. (18.6%), *Penicillium* spp. (15.5%), *Alternaria* spp. (13.0%) and other species (21.0%). The mould concentration was higher in the kitchens than in other parts of the houses such as the living rooms and bedrooms ($p < 0.05$). The fungal flora of the air in the Afyon city region has a seasonal variation.

3. Methods

Air sampling was carried out using Anderson two stage sampler [8] during the period from January 2014 to December 2014. Present study was conducted for the qualitative and quantitative evaluation of different fungal colonies in indoor and outdoor environment of selected residential sites. Sample were collected from different residential areas and situated in Zone VI of Jabalpur (M.P.). Air sample were collected from indoor kitchen area and outdoor environment of the house. Sabourauds Dextrose Agar Medium [9] was used for isolation of fungi. The culture plates were incubated in inverted position at 28°C for 3 to 5 days depending upon the growth of colonies. Colonies were counted and identified. The total number of colony forming units (CFU) per plates was calculated. The pure culture was maintained at 4 ºC and identified with help of standard literature [10] – [16].

The slide culture technique [17] is used to observe morphological characteristics of molds without disturbing the arrangement of spores and conidial ontogeny over a period of time in a given area of the preparation.

4. Results/ Discussion

Fungi are found worldwide and reproduce rapidly. The distribution of aeroallergens changes from country to country and even within regions of the same country. Indoor

fungi are a mixture of those which have entered from outdoors and those which readily grow and multiply indoors. *Aspergillus* and *Penicillium* are less common outdoors and are usually considered the major indoor fungi [18], [19].

As a result of the present study, altogether 30 types of fungal cultures were isolated using Anderson two stage sampler, out of 30, 9 belonging to Zygomycotina, 2 belonging to Ascomycotina, and 19 belonging to Deuteromycotina. Verma et al. [20] also found 20 different type of fungal spores during the survey of kitchen environment from which 3 type of fungal isolates were identified in Zygomycetes, 3 from Ascomycetes, and 14 in Deuteromycetes.

Great concern has been expressed about potential health hazards to humans, with a special focus on allergenic or toxigenic fungi and their association with air quality [21]. The zone six shows during the survey year 2014, *Penicillium notatum* , *Alternaria tenius, Alternaria* sp., *Mucor* sp.. and *Mucor racimosus,* were among the highest fungal spores. Mushtaq et al. [22] also found that most frequently isolated fungal genera were *Alternaria, Aspergillus, Cladosporium, Fusarium* and *Penicillium* in study area.

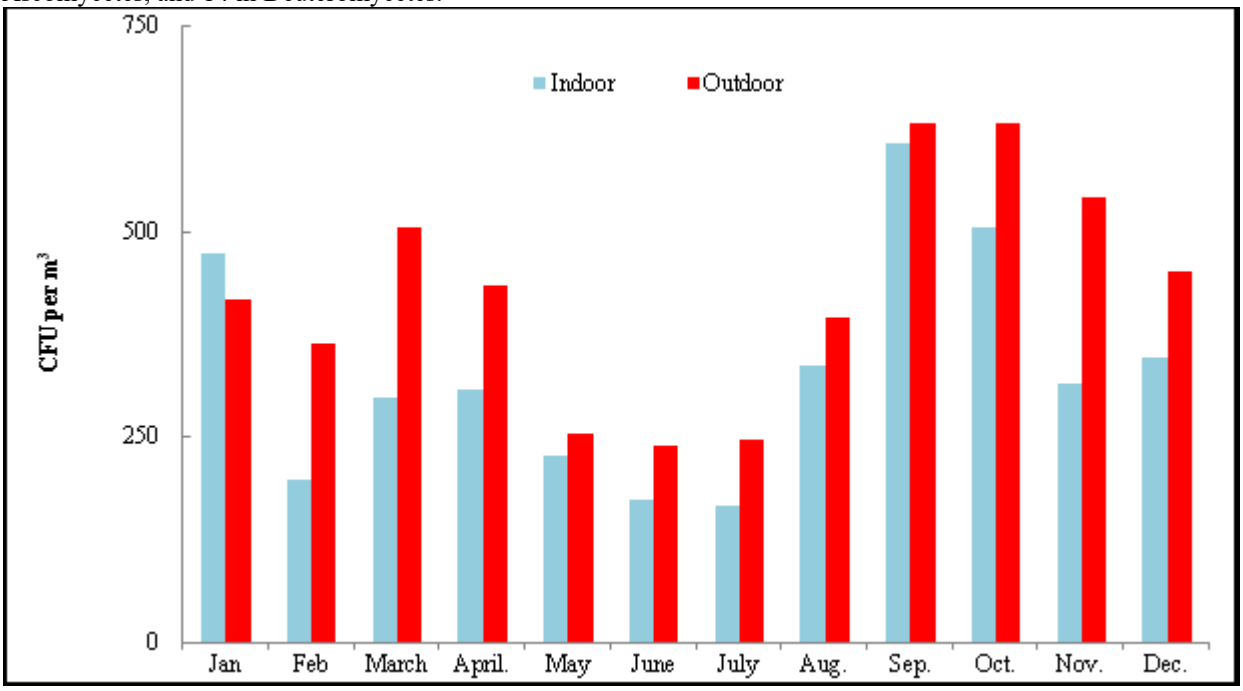

Figure: Enumeration of fungi (CFU per m^3) from Zone VI during 2014.

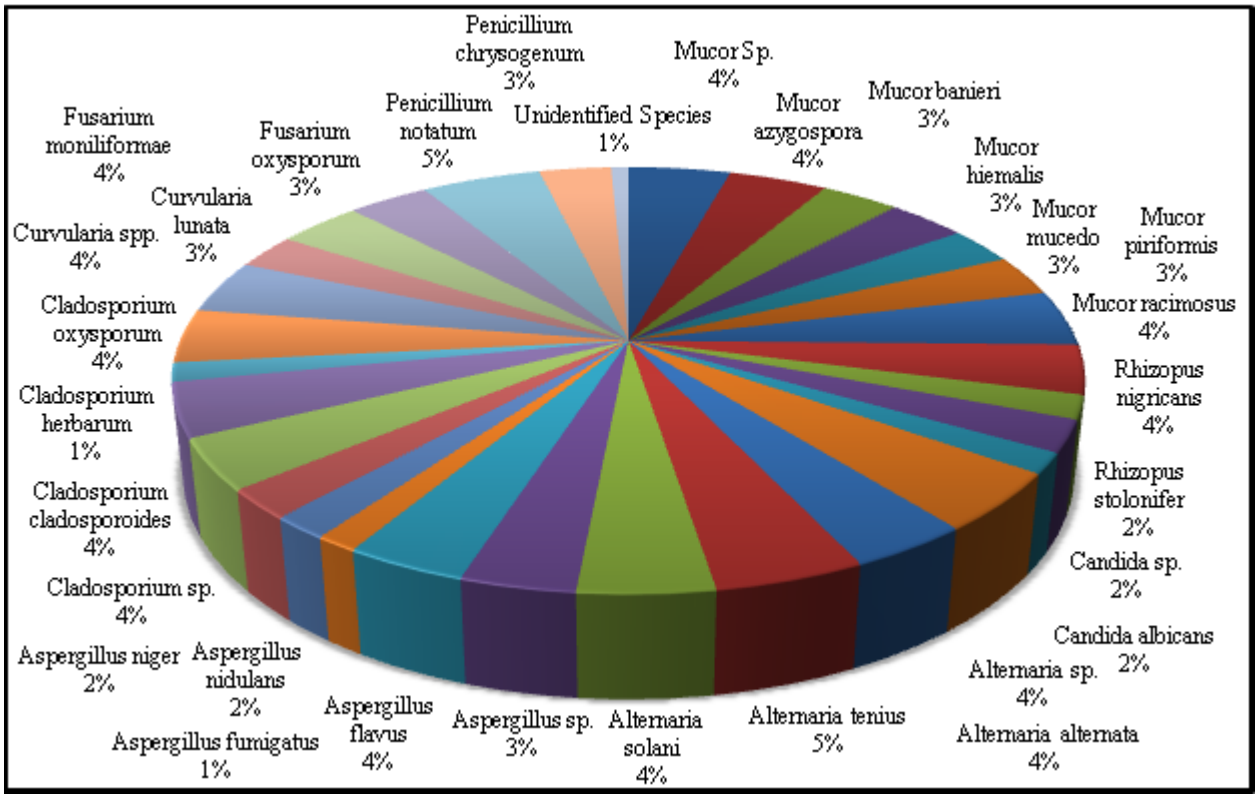

Figure: Percentage of fungi in Zone VI during 2014

This study shows a comparative account of fungal counts in indoor and outdoor environments of the kitches in Zone VI during 2014. During the year 2014, 3946 CFU m^{-3} in indoor and 5111 CFU m^{-3} in outdoor kitchen environments were recorded.

This study presents the involvement of major fungal species into the total air burden of the kitchen in zone VI. Overall, *Penicillium notatum* (5.06%), *A. tenius* (4.52%), *Alternaria* sp. (4.44%), *Mucor* sp.(4.32%) and *Mucor racemosus* (4.2%) were the highest prevailing fungi during 2014 in zone VI. Reddi et al. [23] also found higher fungal counts in indoor environments and *Aspergillus* and *Penicillium* were the dominant fungi in indoor environments.

The graph compares the fungal counts month wise in both indoor and outdoor environments in zone VI during 2014. It was observed that except for the months of January, the indoor environment has less number of fungal spores in comparison to indoor kitchen environment in zone VI.

5. Conclusion

The concentration of fungal spores in any given environment is largely dependent on the availability of nutrition, moisture, wind flow and temperature. In Indian homes, kitchen is an indispensible part of house hold and housewives spend most of their time in kitchens. The kitchens are considered to be vulnerable for fungal growth due to large amounts of water used for cleaning as well as damp areas and waste food items. In this present study it was found that fungal level of kitchen can vary to large extent, due to both environmental and anthropogenic reasons. Monthly variation also recorded due to slight differences in meteorological parameters in different months. The outdoor and indoor airspora shows a close correlation qualitatively and quantitatively. The predominance of fungal spore types, the dominance of Deuteromycotina followed by other fungal groups, concentration of individual fungal spore types, Allergic and pathogenic spore types shows close correlation in occurrence and concentration in the indoor and outdoor airspora.

Higher mold concentration was observed in kitchens therefore this environment may promote mold growth due to high relative humidity (RH) the existence of potential substrate. Therefore increasing the ventilation rate by means of mechanical or natural system can play a key role in improving the kitchen air quality.

6. Future Scope

It will be helpful to establish correlation between fungal allergen in air and kitchen environment, thus achieving effective management of allergic disorder. This work is helpful to enumerate such allergens and in future can be refer by health department, government policies in health planning scheme and also beneficial for further clinical investigation. This study will help the allergologist in the preparation of fungal calendar of Jabalpur city. This study can be helpful in identifying associations between kitchen fungal species profiles and clinical finding and prevention of seasonal allergic diseases.

References

[1] H.A. Burge, “Airborne allergic fungi Classification, Nomenclature and distribution”, Immunol. Allergy Clin. North Am. 9, pp. 307-98, 1989, 1992.
[2] D.P. Strachan, “Damp housing and childhood asthma: validation of reporting of symptoms”, B.M.J. 297, pp. 1223–6, 1988.
[3] S.D. Platt, C.J. Martin and C.W. Lewis, “Damp housing, mold growth, and symptomatic health state”, B.M.J. 298, pp. 1673–8, 1989.
[4] A.K. Ayachi, R.K. Shrivastava, A. Bajpai and A. Sen, “Studies on the presence of aeromycoflora at gelatin factory, Bhedaghat, Jabalpur”, Sci-Fronts V (5), pp. 83-90, 2011.
[5] R.E. Dales, D. Miller and E.D. McMullen, “Indoor air quality and health: validity and determinants of reported home dampness and moulds”, International Journal of Epidemiology, 26 (1), pp.120-125, 1997.
[6] P.R. Morey, M.C. Hull and M. Andrew, “El Nino water leaks identify rooms with concealed mould growth and degraded indoor air quality”, International biodeterioration & biodegradation, 52 (3), pp. 197-202, 2003.
[7] Z. Cetinkaya, F. Fidan, M. Unlu, I. Hasenekoglu, L. Tetik and R. Demirel, “Assessment of indoor air fungi in Western-Anatolia, Turkey”, Asian Pacific Journal of Allergy and Immunology, 23 (2-3), pp.87, 2005.
[8] A.A. Anderson “New sampler for the collection sizing and enumeration of viable air borne particles”, Journal of Bacteriology, 76, pp. 471-484, 1958.
[9] P.N. Chowdhary, Manual on identification of plant pathogenic and agricultural importance, 2000.
[10] F. E. Clements and C.L. Shear, The Genera of fungi, Hanfer publishing Co. New York, pp. 496, 1954.
[11] H.L. Barnett, Illustrated genera of Imperfect fungi, Minn: Burges publishing Company, New York, 1960.
[12] M.B. Ellis, Dematianceous Hyphomycetes common wealth mycological. Institute Kew, survey, England, pp. 608, 1971.
[13] C.V. Subramaniam, Hyphomycetes, New Delhi, ICMR, pp. 930, 1971.
[14] R.W.G. Dennis and J. Cramer, British “Ascomycetes” Inder A.R. Ganter Verlag Kammanditgese, 11-Shapt. F.L.9490, VADOZ, Germany, pp. 585, 1978.
[15] S.T. Tilak, Airborne pollen and fungal spores Vijayanti Prakashan, Aurangabad, 1989.
[16] K. Schubert, J. Z. Groenewald, U. Braun, J. Dijksterhuis, M. Starink, C.F. Hill, P. Zalar, G.S. Hoog de and P.W. Crous, Biodiversity in the Cladosporium herbarum complex (Daviedellaceae, Capnodiales), with standardization of methods for Cladosporium taxonomy and diagnostics Stud. Mycol. 58, pp. 105-156, 2007.
[17] E.A. Johnson, “An improved slide culture technique for the study and identification of pathogenic fungi”, J. Bact. 43 (16), 1946.
[18] H.A. Burge, “Fungus allergens”, Clin. Rev. Allergy, 3, pp. 319–29, 1985.
[19] K. Licorish, H.S. Novey and P. Kozak, “Role of *Alternaria* and *Penicillium* spores in the pathogenesis of asthma”, J. Allergy Clin. Immunol. 76, pp. 819–25, 1985.

[20] K.S. Verma, A. Verma, V. Jain and M. Mishra, "Immunological study of airborne fungal allergens in the kitchen environment", Vishlashan, 3, pp. 48-51, 2009.
[21] W. E. Horner, A. Helbling, J. E. Salvaggio and S. B. Lehrer, Fungal allergens, Clin. Microbiol. Rev. 8, pp. 161-179, 1995.
[22] S. Mushtaq, M.S. Haider, I. Mukhtar and I. Khokhar, "Species Of Deuteromycetes (Fungi Imperfect) Present At Residential Houses In Railway Colony Lahore, Pakistan", Pak. J. Phytopathol. 23 (2), pp. 118-124, 2011.
[23] S.C. Reddi, J.B. Atluri, N. Rao and K. Shrivandana, "The relation between indoor and outdoor fungal airspora of some working environments", Indian Journal of Aerobiology, 17(1&2), pp. 44-52, 2004.

Author Profile

Ruchi Koshta has received B.Sc. and M.Sc. degrees from Rani Durgavati University, Jabalpur, M.P. in the year 2010 and 2012 respectively. Now she is a Ph.D. Research Scholar in Rani Durvati University, Jabalpur, M.P.

Akhilesh Ayachi joined Government Model Science College, Jabalpur, M.P. in the year 1987 as Assistant Professor. During 2006 – 2015 he stayed in Government Model Science College, Jabalpur, M.P as a Professor. Now he is a Principal Incharge and Professor in Government P.G. College, Niwari, District Tikamgarh

S.No.	Fungal isolates	Jan.		Feb.		Mar.		Apr.		May		June		July		Aug.		Sep.		Oct.		Nov.		Dec.		Total			CFU			%		
		I	O	I	O	I	O	I	O	I	O	I	O	I	O	I	O	I	O	I	O	I	O	I	O	I	O	T	I	O	T	I	O	T
	Zygomycotina																																		
1	*Mucor Sp.*	8	4	7	0	10	10	8	8	3	7	1	2	0	6	9	4	7	5	5	0	0	1	0	5	58	53	111	204.74	187.09	391.83	5.19	3.66	4.32
2	*Mucor azygospora*	4	5	1	6	3	9	5	7	1	1	1	8	5	9	3	10	8	1	2	6	1	2	6	3	40	67	107	141.2	236.51	377.71	3.58	4.63	4.17
3	*Mucor banieri*	0	2	4	2	5	5	0	6	0	3	0	8	1	1	2	5	7	9	5	12	1	5	0	2	25	60	85	88.25	211.8	300.05	2.24	4.14	3.31
4	*Mucor hiemalis*	8	2	0	10	0	2	0	5	0	7	0	1	2	0	7	6	6	5	5	0	4	7	3	6	35	51	86	123.55	180.03	303.58	3.13	3.52	3.35
5	*Mucor mucedo*	0	10	0	8	0	1	3	0	2	3	2	7	0	0	0	0	3	9	5	5	2	4	2	6	19	53	72	67.07	187.09	254.16	1.7	3.66	2.8
6	*Mucor piriformis*	7	0	4	6	1	7	0	5	0	6	0	0	2	5	0	2	8	0	2	8	2	12	1	2	27	53	80	95.31	187.09	282.4	2.41	3.66	3.12
7	*Mucor racimosus*	7	1	2	0	8	2	12	5	0	4	0	3	3	2	7	7	7	9	6	7	5	5	5	1	62	46	108	218.86	162.38	381.24	5.54	3.18	4.21
8	*Rhizopus nigricans*	8	6	1	1	2	10	3	5	0	0	0	0	0	0	12	4	4	14	3	12	1	2	5	3	39	57	96	137.67	201.21	338.88	3.49	3.94	3.74
9	*Rhizopus stolonifer*	0	5	0	2	1	1	0	0	2	0	1	0	1	0	1	1	0	7	8	8	0	0	4	4	18	28	46	63.54	98.84	162.38	1.61	1.93	1.79
Ascomycotina																																		
1	*Candida sp.*	7	0	0	0	0	0	1	8	0	4	0	2	1	0	4	6	0	5	8	4	6	6	0	0	27	35	62	95.31	123.55	218.86	2.41	2.42	2.42
2	*Candida albicans*	5	5	0	0	0	0	0	0	0	0	0	0	0	0	1	2	0	8	2	2	1	1	6	7	15	25	40	52.95	88.25	141.2	1.36	1.73	1.56
	Deuteromycotina																																	
1	*Alternaria sp.*	9	0	4	0	7	12	4	2	1	0	2	2	0	1	0	1	10	6	12	15	8	14	2	2	59	55	114	208.27	194.15	402.42	5.28	3.8	4.44

2	*Alternaria alternata*	0	12	0	14	2	2	4	0	1	0	0	1	0	6	1	2	7	2	8	6	1	7	8	10	32	62	94	112.96	218.86	331.82	2.87	4.28	3.66
3	*Alternaria tenius*	8	10	4	2	6	8	7	5	0	6	1	1	4	1	7	8	5	5	5	4	4	3	2	8	56	60	116	197.68	211.8	409.48	5.02	4.14	4.52
4	*Alternaria solani*	8	1	2	10	7	13	2	18	3	1	1	0	7	2	0	0	0	5	4	7	1	2	0	6	42	63	105	148.26	222.39	370.65	3.76	4.35	4.09
5	*Aspergillus sp.*	4	10	2	3	1	5	0	2	0	0	10	1	2	7	8	9	4	7	8	7	8	9	5	5	38	51	89	134.14	180.03	314.17	3.4	3.52	3.47
6	*Aspergillus flavus*	0	6	0	8	1	10	0	2	5	2	4	0	4	0	2	5	6	5	10	1	2	2	10	6	33	61	94	116.49	215.33	331.82	2.97	4.21	3.66
7	*Aspergillus fumigatus*	7	4	1	0	2	0	3	0	4	0	0	0	0	0	0	0	0	0	0	4	0	0	4	4	25	8	33	88.25	28.24	116.49	2.24	0.55	1.28
8	*Aspergillus nidulans*	1	0	0	1	0	1	3	3	5	2	4	1	1	1	0	0	0	8	2	2	1	3	0	4	21	24	45	74.13	84.72	158.85	1.89	1.66	1.75
9	*Aspergillus niger*	1	1	1	4	0	3	0	5	2	2	0	0	1	0	0	0	0	10	8	5	0	3	6	2	23	35	58	81.19	123.55	204.74	2.07	2.42	2.26
10	*Cladosporium sp.*	1	2	0	4	0	6	1	8	0	7	4	9	6	6	14	10	1	6	0	2	4	1	6	1	37	62	99	130.61	218.86	349.47	3.32	4.28	3.86
11	*Cladosporium cladosporoides*	3	5	0	9	4	5	2	8	6	7	1	1	0	3	0	0	12	10	5	5	4	6	2	7	37	68	105	130.61	240.04	370.65	3.32	4.7	4.09
12	*Cladosporium herbarum*	1	0	0	0	0	4	0	8	0	2	0	0	0	0	4	0	2	0	6	5	0	1	7	1	11	26	37	38.83	91.78	130.61	0.98	1.8	1.44
13	*Cladosporium oxysporum*	4	0	2	5	0	6	0	4	2	5	3	2	1	10	8	9	8	4	7	3	2	10	3	3	36	69	105	127.08	243.57	370.65	3.24	4.76	4.09
14	*Curvularia spp.*	8	1	5	3	4	8	6	1	10	0	2	0	1	8	5	9	6	8	2	4	3	2	4	0	64	40	104	225.92	141.2	367.12	5.73	2.76	4.05
15	*Curvularia lunata*	3	2	3	0	3	0	3	0	0	1	8	5	0	2	2	4	2	0	8	10	2	0	4	8	30	38	68	105.9	134.14	240.04	2.69	2.62	2.65
16	*Fusarium moniliformae*	4	6	2	1	2	0	2	0	0	0	0	3	0	1	8	8	9	4	5	5	8	9	5	10	39	53	92	137.67	187.09	324.76	3.49	3.66	3.58
17	*Fusarium oxysporum*	5	7	6	0	4	3	6	1	6	0	8	0	3	0	4	2	6	8	1	10	2	6	2	4	42	46	88	148.26	162.38	310.64	3.76	3.18	3.43
18	*Penicilliium notatum*	9	4	4	2	9	6	9	6	9	1	5	0	5	0	2	2	10	7	8	3	9	8	8	2	86	44	130	303.58	155.32	458.9	7.69	3.04	5.06
19	*Penicillium chrysogenum*	3	0	0	0	0	2	2	0	2	1	0	0	0	10	5	0	2	8	1	10	5	9	3	10	35	43	78	123.55	151.79	275.34	3.15	2.97	3.04
20	**Unidentified Species**	1	7	1	1	2	2	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	7	12	19	24.71	42.36	67.07	0.63	0.83	0.74
	GrandTotal	134	118	56	103	84	143	87	123	64	72	49	68	47	70	95	112	172	179	143	179	89	153	98	128	1118	1448	2566	3947	5111	9058	100	100	100