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Assessment of microbial contamination of air at workplace: Need of the hour

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Abstract

The relation between workers and working environments are interdependent and dynamic in nature. Air affects the quality and productivity of life directly or indirectly. The indoor air quality is one of the most significant factors affecting the health and well-being of people at work. Air pollution has been defined as the presence of toxic chemicals or compounds in the air, at levels that pose a health risk. The role of biological materials in causation of bad air has not been given due attention. Viable particles suspended in air form a distinct class of contaminant. Periodical isolation of aeromicrobes of each month from selected experimental site at 1.5 m height was done using rotorod air sampler and followed by exposing petriplates containing MacConkey medium through gravitational sampling technique. Aeroallergic microbes and spores were isolated during the period of investigation. Seasonal variation in aeromicrobial load with rainy season showing the highest aeromicrobial load was observed. Strategies for the control of biological aerosols in indoor air are the need of hour.

Keywords: assessment, mirobial contamination, need of the hour, workplace

Introduction

The workers and working environments are interdependent, reciprocally reactive and inter-related complex entities. The working environments are indeed an inseparable holistic system constituted by physical, chemical and biological components of environment and socio-cultural behavior of the working population. Air is one of the most essential requirements for the survival of mankind and other animals on this planet. Air affects the quality and productivity of life directly or indirectly. The indoor air quality is one of the most significant factors affecting the health and well-being of people at work. The gradual and rapid development of working environments with aim to cope up with the socio-economic and biological needs have certainly affected the ecological balance and ultimately resulted in the deterioration of working environments. Consequently in the recent time air pollution has dragged the attention of scientists and people worldwide.

Air pollution has been defined as the presence of toxic chemicals or compounds (including those of biological origin) in the air, at levels that pose a health risk. In an even broader sense, air pollution means the presence of chemicals or compounds in the air which are usually not present and which lower the quality of the air or cause detrimental changes to the quality of life. Many cities in South-East Asia face poor air quality throughout the year . Pollutants include ozone, oxides of nitrogen, sulfur dioxide, and carbon monoxide, as well as fine particulate matter. The role of physical factors in the deterioration of surrounding air has been stressed upon significantly but the role of biological materials in causation of bad air has not been given due attention. Viable particles suspended in air, and other biologically derived particles in indoor air form a distinct class of contaminant. When they are present in indoor air, even in small quantities, they can have a powerful effect on occupants. This effect can be through infection of the occupant by a suspended infectious agent, in which case the organism multiplies in the new host and can produce illness. There can also be allergic or irritant effects characterized by reactions ranging from uncomfortable to disabling. Microbiological materials contaminating indoor environment include moulds and fungi, viruses, bacteria, algae, pollens, spores and their derivatives and are collectively called Bio-aerosols.

Microbial air quality in processing and packaging areas is a critical control point in the processing of dairy products, since airborne contamination reduces shelf-life and may serve as a vehicle for transmitting spoilage and pathogenic organisms. Dairy products provide congenial conditions for the growth of microorganisms. The main sources of airborne organisms in the dairy processing area includes the activity of factory personnel, dairy equipments, floor drains, ventilation and air-conditioning systems,

Spore-forming bacteria and fungi stay viable for a longer time in the air. Inhalation, ingestion and dermal contact are the routes of human exposure to airborne microorganisms, inhalation being the predominant. The particles in a bio- aerosol are generally 0.3 to 100 µm in diameter; however, the respirable size fraction of 1 to 10 µm is of primary concern. Bio-aerosols ranging in size from 1.0 to 5.0 µm generally generally remain in the air, whereas larger particles are deposited on surfaces. Indoor air quality is one of the most significant factors affecting the health and well-being of people. Exposure to air borne bacteria and fungi causes potential biological hazard and have been associated with adverse health effects. Various studies suggest that the distribution of microorganisms in the air, varies among geographic areas and is also influenced by seasonal environmental and climatic factors such as temperature, humidity, time and wind speed. Significant monthly variation and daily fluctuation (time of sampling) in concentrations of airborne bioparticulates in various work places have been studied. Kang et al and Pathak et al studied the microbial quality of air in dairy processing plants. There are many diseases that have been associated with problems of indoor air quality. Tilak (1989) and Alturi et al (1990) reported that aeromicrobial forms are well known for causing diseases of allergic and infectious categories in human beings. They may be acute or chronic, and may deteriorate or improve in relation to biological aerosol exposure. Bio-aerosols contribute to about 5-34% of indoor air pollution. Moisture content of the air affects the breeding and survival of infective microorganism & their pathogenic cystic forms.

Dairy plants have flourished in different parts of our country. However, there is a paucity of literature on the microbial contamination of air. We carried out an assessment of microbial contamination of air in a dairy plant.

Material and Methods

Study was conducted at Ara town in Bihar during June 2009 to May 2011 in the following manner-

1. Periodical isolation of aeromicrobes on 10th & 25th of each month from selected experimental site at 1.5 m height with rotorod air sampler followed by exposing petriplates containing Mac conkey medium through

gravitational sampling technique at 8:30 and 17:30/18:30 hours inside Sudha dairy plant, Ara.

2. Arms of rotorod adhered with glycerine jelly coated cello tapes were exposed for 10 min at each diurnal hour.
3. Analysis of microbial load on diurnal and seasonal basis.
4. Statistical analysis of the obtained data.

The rotorod air sampler used during study has been fabricated, designed and improved by Sinha, Mishra and Singh (1990). Microbes were identified by-

1. morphological characters
2. visual identification by comparision with reference slides

Result

Aeromicrobial load was calculated by number of various microbes trapped per /m^3 of air sampled. Seasonal and diurnal variations of total fungal spora & other miscellaneous types of biota expressed as per metre (m^3) of sampled air were noted during the study.

Table 1: Monthly estimated number of aeromicrobes /m^3 of the sampled air during June 2009-May 2011.

S.No.	Class of aeromicrobes	year	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Jan.	Feb.	March	April	May
1	Zygomycotina	A	540	780	948	948	780	306	174	144	42	6	-	-
		B	354	588	540	726	480	156	150	144	66	6	42	30
2	Ascomycotina	A	424	528	594	480	456	426	348	168	120	216	264	234
		B	384	624	708	768	438	528	486	222	138	204	264	264
3	Basidiomycotina	A	240	258	384	360	336	216	72	120	84	90	96	-
		B	192	222	330	324	336	174	162	168	60	48	30	-
4	Deuteromycotina	A	1098	1458	1596	1548	1230	1050	864	522	876	888	780	632
		B	888	1330	1476	1410	1176	900	630	486	726	852	720	558

A: 2009-10, B: 2010-11

All the airborne bioparticulates trapped during study were broadly classified in to two groups.

Group 1: comprising Zygomycotina, Ascomycotina, Basidiomycotina & Dueteromycotina

Group 2: comprised of Protozoa (cysts & *E. coli*), pollen grains, insect scales and unidentified plant trichomes (Miscellaneous microbes).

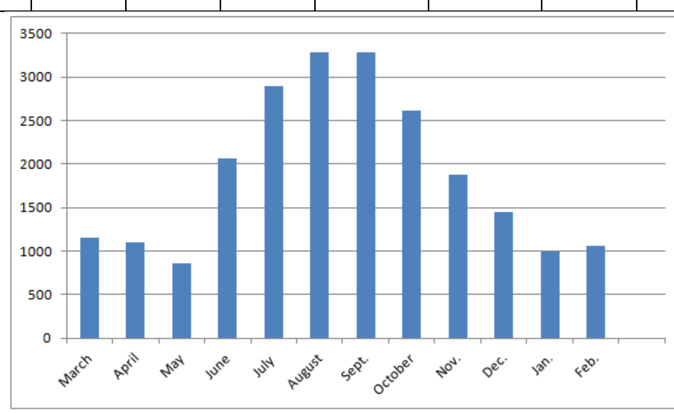

Figure 1: Monthly variations of fungal microbes/m^3 of the sampled air.

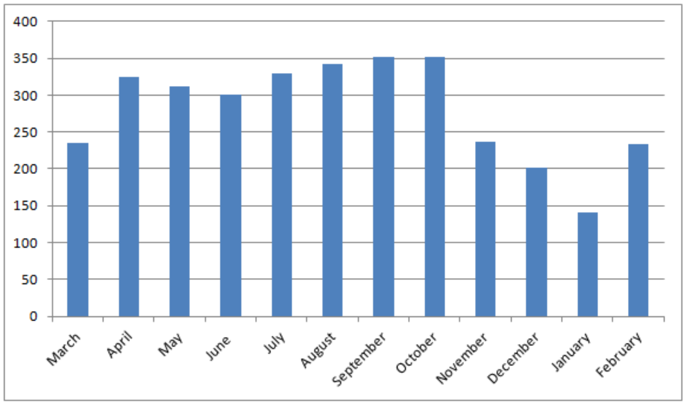

Figure 2: Monthly variation of miscellaneous microbes/m^3 of the sampled air.

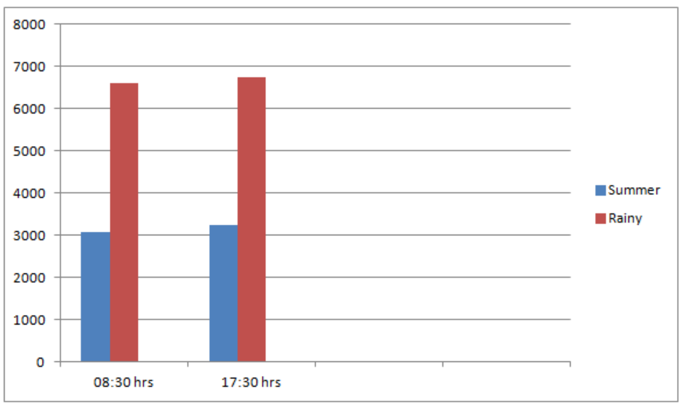

Figure 3: Diurnal variations of microbes/m^3 of the sampled air collected

All the prepared slides were examined under low and high power of microscope. Altogether 29 genera of fungal spores were noted. Those found throughout the year were called "**Dominant genera**" whereas those found in particular months were called as "**Specific genera**".

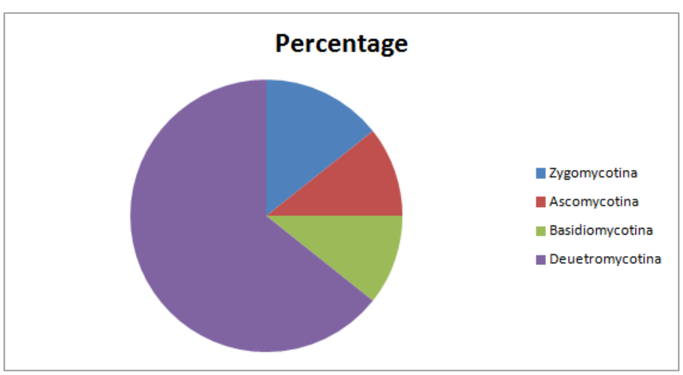

Figure 4: Contribution of various classes of fungi

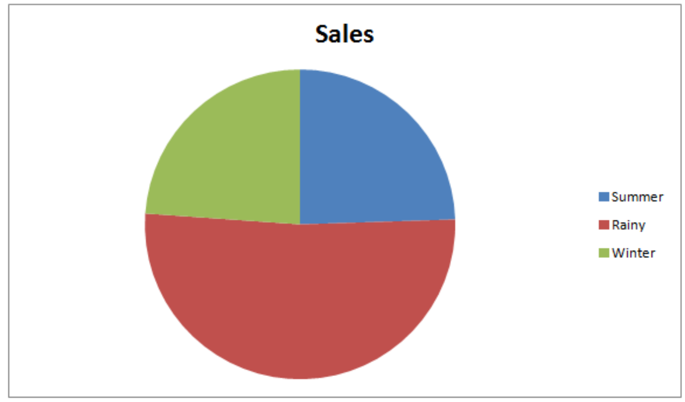

Figure 5: Seasonal variation in contribution of total microbes/m^3 of the sampled air

Fungal spores noted during the study were *Chaetomium, Alternaria, Aspergillus, Cladosporium, Drechslera, Mucor, Penicillium, Rhizopus, Leptosphaeria, Memnoniella, Helminthosporium, Nigrospora, Syncephalastrum, Fusarium, Epicoccu;*. with *Chaetomium* contributing the most 13.8 percent. Other bioparticulates noted were pollen grains of *Parthenium & Ricinus*, pathogenic protozoal cysts & enterobacteria , insects scales and wings.

Discussion and Conclusion

Aerobiology has an important role in the welfare of mankind and other biotic communities of the ecosystem. Tilak (1989) and Alturi et al (1990) reported that aeromicrobial forms are well known for causing diseases of allergic and infectious categories in human beings. Monitoring of air quality inside and around dairy farms or dairy barns has not been taken seriously in our state despite well flourished dairy industries in several towns. Dairy plants have become an indispensable part of our society in terms of business and health protection. The present study was undertaken to assess the microbial contamination of air of the dairy plant. This study clearly envisages the role of airborne bioparticulates on deteriorating air quality and its bad impact on our health. Pollens and several fungal spores isolated during the study are known to induce allergic diseases like asthma, rhinitis, sinusitis, bronchitis, conjunctivitis, hay fever, etc. *Escherichia coli* and protozoan cysts may contaminate the milk and milk products leading to infective diseases in consumers.Similar findings have been reported by earlier workers- Blom et al (1984), Lacey et-al (1991), Hanhela et-al (1995) at Finnish cow barns, & Duchaine et-al(1995) at dairy barns of Canada. In our country Adhikari et-al (2004) also reported similar findings at Dairy cattle farm in Howrah district of West Bengal.

A sincere attempt was made to find out interrelationship between aeromicrobial forms and factors affecting them. Seasonal variation in aeromicrobial load with rainy season showing the highest aeromicrobial load was observed. Sudarshanam et al (2011) and Burge (1990) also reported effect of bioaerosls on health. Strategies for the control of biological aerosols in indoor air are predominantly based on the avoidance of conditions that provide a substrate for the growth of viable particles, and secondarily on the containment and removal of such factors. Control of microbial contamination of the workplace will surely improve the working capacity of workers reduce the absenteeism due to bad health.

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