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Optimized Reduction of Biopollutants: Is It Possible?

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***Abstract*: Biopollutants or Biocontaminants are produced by living things which include mold, dust mites, droppings and body parts from insects and other various microbes which lead to different allergic diseases. An attempt has been performed to record the incidence of biopollutants in research laboratory of Nirmala College for Women, Coimbatore followed by standardization of fumigation and sterilization conditions in order to control the outburst of biopollutants. Petriplate settlement technique and biological pollution index were applied for evaluation. During monsoon and winter season, incidences of fungal species were found to be more compared to bacterial species. During summer season, bacterial group found to be more compared to fungi group. Hence, a simple methodology of the right proportion of fumigation and sterilization was optimized.**

***Keywords*: Biopollutants, Nirmala College for Women, fumigation and sterilization, Biological pollution index, Ultra violet irradiation, Petriplate settlement technique.**

I. INTRODUCTION

Pollution or Environmental toxicology proves to be hazardous for human health due to over population, deforestation and industrialization. Pollution is of various types which include water, soil and air. Among them, air pollution seems to be more dangerous due to presence of large number of microscopic contaminants like dust, pollen and microbes in environment. Presence of harmful microbes in environment leads to biopollution. The biopollutants in atmosphere have been found to cause allergy leading to asthma, skin diseases and cardiovascular diseases. Gregory 1952 suggested the term 'Air spore' to describe the fungal spore and pollen flora. The incidence and nature of allergic air borne pollen grains and spores vary from place to place which demands a clean understanding of their prevalence in a particular area. Our present study aims at recording the incidence of biopollutants in research laboratory of Nirmala College for Women, Coimbatore. Apart from recording its count, standardization of fumigation and sterilization conditions have also been performed in order to control the outburst of biopollutants.

II. MATERIALS AND METHODS

Study Area

The research laboratory in Nirmala College for Women was chosen as a study site to detect the common biopollutants present in air.

Data Collection

For a sufficient database, the examined study area was investigated for the duration of one year (December 2012 to December 2013).

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Sampling

After doing the regular fumigation, the dominant microbes have been detected by following the petriplate settlement technique. Nutrient agar and Sabourauds agar were placed in the centre of UV chamber at the height of 35 cm from UV light, by keeping the lid open for 24 hours.

Biological Pollution Index [1]

Biological Pollution index proposed by Olenin *et al* [3] was applied to enumerate the biocontaminant count which follows a specific literal code instead of numerical count. Firstly, the ADR class (abundance and distribution range) for each species in every assessment unit was determined. If the species occurred only in small numbers, its abundance was ranked as "low". Abundance was ranked as "moderate" if the species made up less than a half of the population and "high" where an alien species constituted more than 50% of the native community. A distribution classification of "one locality" was recorded when the species occurred only in one sampling station of an assessment unit. If the species was distributed in more than one locality but less than half of the stations, its distribution was classified as "several localities". "Many localities" was used when the species was spread over half of the stations. "All localities" was used when the species occurred all over the sampling area. The impact of the species is ranked as no impact (0), weak impact (1), moderate (2), strong (3) and massive impact (4). The sum of the evaluation of each impact and the ADR (Abundance & Distribution Range) class results in a Biopollution Level (BPL), ranging from 0 (No impact) to 4 (Massive impact).

Method to Control Fumigation

To control the growth of biocontaminants, UV sterilization along with chemical fumigation has to be performed. A particular concentration of potassium permanganate ($KMnO_{4)}$ along with formaldehyde (HCHO) has been used as chemical fumigant.

III. RESULT

Biopollutant detection has been carried out in the research lab of Nirmala College for Women, Coimbatore for the period of one year (December 2012 to December 2013).

Before performing the laboratory work, UV sterilization was performed for half an hour. After petriplate settlement technique, microbes like *Aspergillus* sp, *Penicillium* sp. and *Bacillus* sp were found as common environmental biopollutant.

TABLE I: Prevalence of biopollutants in the Research laboratory monthwise

Months	Dominant biopollutant
December 2012	A.niger, A.flavus and A.fumigatus
January 2013	A.niger, A.flavus, A.fumigatus and Penicillium sp.
February 2013	A.flavus, Bacillus sp. Penicillium sp.
March 2013	Bacillus sp. Penicillium sp. A.flavus
April 2013	.Bacillus sp. A.niger, A.fumigatus
May 2013	Bacillus sp. A.niger, A.fumigatus
June 2013	Bacillus sp. A.flavus, A.fumigatus
July 2013	A.niger, A.flavus, A.fumigatus & Penicillium sp.
August 2013	A.niger, and Penicillium sp.
September 2013	A.niger, A.flavus, A.fumigatus
October 2013	A.niger, A.flavus, and Penicillium sp
November 2013	A.niger, A.fumigatus and Penicillium sp
December 2013	A.niger, A.flavus, A.fumigatus & Penicillium sp

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During monsoon and winter season, incidence of fungal species especially *Aspergillus* sp i.e., *A.niger*, *A.flavus* and *A.fumigatus* were found to be more followed by *Penicillium* sp. compared to *Bacillus* sp. contaminant. During summer season, *Bacillus* sp. found to be more compared to fungi group.

TABLE: II. Biological Pollution Index (BPI) in Research lab of Nirmala College

Months	Abundance	Distribution	Impact	BPI
December 2012	Low	one locality	0	0
January 2013	Moderate	one locality	1	1
February 2013	Moderate	one locality	1	1
March 2013	Moderate	one locality	1	1
April 2013	Low	one locality	0	0
May 2013	Low	one locality	0	0
June 2013	Moderate	one locality	1	1
July 2013	Moderate	one locality	1	1
August 2013	Moderate	one locality	1	1
September 2013	Low	one locality	0	0
October 2013	Low	one locality	0	0
November 2013	Moderate	one locality	1	1
December 2013	Low	one locality	0	0

In order to get rid of both bacterial and fungal biopollutants from research lab throughout the year, the fumigation procedure has been formulated with different concentration.

Table III: Sterilization with different proportion

Physical sterilization	Chemical sterilization	Effect of sterilization
UV 1 hour	(1 gram) $KMnO_4$ + HCHO (10 ml)	No effect
UV 1 hour	(1.5 grams) $KMnO_4$ + HCHO (20 ml)	No effect
UV 2 hours	(1 gram) $KMnO_4$ + HCHO (10 ml)	No effect
UV 2 hours	(1.5 gram) $KMnO_4$ + HCHO (20 ml)	Positive effect

Inoculation chamber should be fumigated by adding 1.5 grams of potassium permanganate with 20 ml of formaldehyde and kept closed for 24-36 hours. Before starting the research work, the inoculation chamber should be wiped with 95% ethanol and pre sterilized with UV irradiation for two hours.

Other measures to be taken to reduce bio-pollutants [2, 4]

1. Usage of air conditioners and dehumidifiers which should be cleaned according to manufacturer's instructions.
2. Maintenance of humidity level below 50% can prevent water condensation on building materials
3. Usage of exhaust fans that are vented to the outdoors which can eliminate moisture.

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IV. DISCUSSION

For the dimension of space around 10.4 inches *10.4 inches, the above said proportion of physical and chemical sterilization has been performed. The same can be effectively implemented at a larger scale level even in industries, hospitals etc. by increasing the proportion of sterilization level accordingly. There is a general limitation in detecting biopollution level index. There is no specific formula in calculating the impact level. The impact level has been declared as low, moderate or high based on the effect of research work or the health of lab personnel.

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