



## RESEARCH ARTICLE

### DUMP YARD: A NICHE FOR MICROORGANISMS

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#### ABSTRACT

Study of microbial diversity is important to understand the microbial ecology and their impact on human and other living beings in the ecosystem. In this study an attempt is made on how the solid waste is becoming breeding ground for the microorganisms thereby causing unpleasant atmosphere to the living beings. Physical properties of the soils pH, soil temperature and soil moisture is recorded and correlated with the microorganism inhabiting the wastes. The mean pH ranges from 6.5 to 7.7, average temperature was from 25°C to 28°C for both non-dumping and dumping sites and percentage of soil moisture was 1% to 2%. Total bacterial counts in dumpsites were 2.62x10<sup>6</sup>cfu/g, 2.25x10<sup>6</sup>cfu/g, 2.85x10<sup>6</sup>cfu/g, 3.01x10<sup>6</sup>cfu/g and non-dumpsites were 1.28x10<sup>6</sup>cfu/g, 1.25x10<sup>6</sup>cfu/g, 2.85x10<sup>6</sup>, 2.42x10<sup>6</sup>cfu/g. The total fungal counts in the dump sites 5.21x10<sup>3</sup>cfu/g, 4.64x10<sup>3</sup>cfu/g, 2.84x10<sup>3</sup>cfu/g, 4.42x10<sup>3</sup>cfu/g and non-dump sites were 3.68x10<sup>3</sup>cfu/g, 2.22x10<sup>3</sup>cfu/g, 3.21x10<sup>3</sup>cfu/g, 2.82x10<sup>3</sup>cfu/g. Some of the bacterial species isolated were *Bacillus* spp., *Escherichia coli*, *Micrococcus* spp., *Pseudomonas* spp. and *Staphylococcus* spp. Dominant fungal species were *Aspergillus niger*, *A. fumigatus*, *A. flavus*, *A. candidus*, *Chaetomium* spp., *Fusarium* spp., *Phoma* spp., *Mucor* spp., and Yeast.

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## INTRODUCTION

Population explosion and rapid urbanization are responsible for the rise in solid waste in the cities which is leading to increase in land and air pollution. Large scale production and improper disposal of solid waste has resulted in serious deterioration in quality of life and the ecological balance (Yaliang, 1996). The average daily waste generation in Hyderabad is 5030 MT/day (Vamsi Krishna et al., 2015). The soils of the dump yards consists of degradable organic matter such as food material, plant material, paper, timber, rags, textile and non-degradable materials like plastics, glass, metals, construction material, rubber etc. Soil microorganisms like fungi and bacteria colonize the waste and degrade the waste (Stainer et al., 1989). The waste is generally disposed improperly or kept at the site for few days which makes the dump yard a breeding ground for flies, insects, bacteria, fungus and many other microorganisms. Foul odor is released creating unpleasant environment for the resident living in and around the area. The runoff water during rainy season contaminates the drinking water and ground water, poses a threat in the form of several health hazards (Jampala et al., 2016). Present study is to find out the diversity of microbes inhabiting the dump yards of the Hyderabad city and its impact on the environment.

## MATERIALS AND METHODS

The soil samples were collected from four different dumping yards (DA) and four non-dumping yards (NDS) (which are located within 1km from the dumping sites) located in and around Hyderabad city to isolate different microorganisms. Soil samples from dumping areas and non-dumping areas were collected at a depth of 10 cm by inserting hand trowel and transferred into sterile polythene bags. Physicochemical characters of the soil like temperature, pH and moisture of each sample were recorded immediately using ePro Labs stainless steel temperature sensor and Touch portable high precision garden plant soil pH meter moisture tester sensor.

The soil samples were subjected to serial dilutions for the quantitative estimation of microorganisms (Waksman 1952). Sabouraud Dextrose Agar medium (SDA) and Nutrient Agar Medium (NA) were used to isolate fungi and bacteria respectively. The duplicate plates were incubated at 30 °C, examined daily and counts were recorded on 3<sup>rd</sup> day for bacteria and yeast and 7<sup>th</sup> day for fungi. The microorganisms were isolated based on their culture and colony characters and maintained separately. Bacterial species were identified with the help of staining and biochemical tests (Olutiola, 1991) and fungi were identified by colony characters and observation of cultures under microscope.

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Table 1. Physiochemical factors of soil from dumping sites (DS) and non-dumping sites (NDS)

Sites	Soil pH	Soil Temp(°C)	Soil Moisture(%)
1 NDS-I	7.2	27.0	1.78
DS-I	6.8	25.2	1.93
2 NDS-II	7.6	27.8	1.21
DS-II	6.7	24.6	1.51
3 NDS-III	7.4	27.1	1.68
DS-III	6.5	25.5	1.81
4 NDS-IV	7.7	27.9	1.07
DS-IV	6.9	26.5	1.23
Sites	Soil pH	Soil Temp(°C)	Soil Moisture (%)
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DS-I	6.8	25.2	1.93
2 NDS-II	7.6	27.8	1.21
DS-II	6.7	24.6	1.51
3 NDS-III	7.4	27.1	1.68
DS-III	6.5	25.5	1.81
4 NDS-IV	7.7	27.9	1.07
DS-IV	6.9	26.5	1.23

Table 2. Frequency of bacterial species isolated from dumping sites (DS) and non-dumping sites (NDS)

S.No	Bacterial species	Site-I		Site-II		Site-III		Site-IV		Mean NDS	Mean DS
		NDS	DS	NDS	DS	NDS	DS	NDS	DS		
1	<i>Bacillus</i> sp	16.6	18.8	-	-	12.5	25.0	-	-	19.7	10.9
2	<i>Escherichia coli</i>	4.77	9.09	9.56	12.0	10.17	12.5	12.5	16.6	9.2	12.5
3	<i>Micrococcus</i> sp	-	12.5	-	9.09	-	-	-	9.09	-	7.67
4	<i>Pseudomonas</i> sp	-	10	-	12.5	-	-	9.09	12.5	2.2	8.75
5	<i>Staphylococcus</i> sp	10.0	12.5	-	-	-	-	16.6	25.0	6.6	9.3

Table 3. Frequency of fungal species isolated from dumping sites (DS) and non-dumping sites (NDS)

S.No	Fungal species	Site-I		Site-II		Site-III		Site-IV		Mean	
		NDS	DS	NDS	DS	NDS	DS	NDS	DS	NDS	DS
1	<i>Aspergillus cadidus</i>	4.8	3.2	4.3	4.4	5.2	6.2	2.3	3.4	4.2	4.0
2	<i>Aspergillus flavus</i>	-	4.8	-	3.4	-	6.6	-	9.5	-	6.0
3	<i>Aspergillus fumigatus</i>	6.8	8.0	3.1	4.7	11.5	14.4	6.3	7.2	6.9	8.5
4	<i>Aspergillus nidulance</i>	-	7.3	-	9.9	-	6.6	9.1	10.5	2.2	8.5
5	<i>Aspergillus niger</i>	21.5	26.3	20.8	29.9	22.7	23.3	20.0	25.9	21.2	26.3
	Total no. of <i>Aspergillus</i> sps	33.1	53.6	28.2	52.3	39.4	57.0	37.7	56.6	34.6	53.3
6	<i>Chaetomium aureum</i>	2.7	3.9	-	3.9	-	-	-	4.2	0.6	3.0
7	<i>Chaetomium globosum</i>	-	3.1	-	-	-	-	2.2	-	0.55	0.77
	Total no. of <i>Chaetomium</i> sps	2.7	7.0	-	3.9	-	-	2.2	4.2	6.9	11.4
8	<i>Cunninghamella echinata</i>	-	2.2	-	-	-	-	-	-	-	0.55
9	<i>Curvularia lunata</i>	3.1	-	-	-	3.4	4.7	-	-	1.6	1.1
10	<i>Fusarium dimarum</i>	8.6	9.1	-	-	-	-	-	2.1	2.1	2.8
11	<i>Fusarium monoliforme</i>	-	-	-	-	4.1	-	-	-	1.0	-
12	<i>Fusarium oxysporum</i>	2.2	-	-	-	3.1	4.7	-	-	1.3	1.1
13	<i>Fusarium Solani</i>	7.3	8.6	-	-	-	-	-	-	1.8	2.1
	Total no of <i>Fusarium</i> sps	18.1	17.7	-	-	7.2	4.7	-	2.1	6.3	5.9
14	<i>Humicola</i>	1.1	2.6	-	-	-	-	3.1	4.1	1.1	1.6
15	<i>Mucor varians</i>	5.6	6.7	9.9	14.4	7.3	8.6	8.1	11.5	7.7	10.3
16	<i>Nigrospora oryzae</i>	2.7	2.7	-	-	-	-	-	6.6	2.3	0.6
17	<i>Penicillium citrinum</i>	3.1	-	-	-	-	-	-	-	0.7	-
18	<i>Penicillium funiculosum</i>	-	-	-	6.6	-	-	-	-	1.6	-
	Total no of <i>Penicillium</i> sps	3.1	-	-	6.6	-	-	-	6.6	0.7	3.3
19	<i>Phoma feckelli</i>	3.3	5.6	-	-	-	-	-	-	0.8	1.4
20	<i>Phoma humicola</i>	-	-	-	-	-	3.3	-	-	-	0.8
21	<i>Phoma nebulosi</i>	-	-	-	3.3	6.6	-	-	-	1.6	0.8
	Total no of <i>Phoma</i> sps	3.3	5.6	-	3.3	6.6	3.3	-	-	9.9	9.7
22	<i>Phycomyces</i> sp	2.1	3.3	3.3	3.3	4.1	6.6	-	-	6.4	3.3
23	<i>Rhizopus nodosus</i>	2.3	3.3	6.1	4.7	2.6	4.7	2.1	4.7	3.2	13.5
24	<i>Sclerotium</i> sp	-	-	-	-	-	-	-	2.1	-	0.5
25	<i>Yeast</i>	24.0	26.4	23.8	28.5	26.5	31.5	36.0	46.6	27.5	33.3

## RESULTS AND DISCUSSION

When waste is dumped on land, microorganisms such as bacteria and fungi proliferate using the components of the waste materials as source of nutrient for growth. Pathogenic microorganisms and harmful chemicals in solid waste can be introduced into the environment when the waste is not properly managed (Wai Ogosu, 2004; Ogbonna et al., 2006). The physiochemical factors like temperature, pH and moisture of the soil of dump sites were recorded to study their impact

on the microorganisms (Table 1). Soil temperature of dumping and non-dumping areas were found to be in the range of 25°C to 28°C and soil moisture ranges from 1% to 2%. These values fell within the mesophilic range of temperatures for most pathogenic bacteria whose optimum temperature for growth is 37°C with upper and lower temperature limits of 40-50 and 15-20°C respectively (Arora, 2004). The pH of the dump sites ranges from 6.5 to 6.9 indicating acidic nature where as non-dumping sites were slightly alkaline ranges from 7.2 to 7.4. Obire et al. (2002)

reported a pH range of 5.4 to 7.9 and temperature of 27-28<sup>0</sup>C, respectively. Moisture content in the soil was in dumping sites slightly higher than non-dumping site. The edaphic factors appeared to have positive effect on the microbial numbers. Total bacterial counts in dumpsites (DS) were 2.62x10<sup>6</sup> cfu/g, 2.25x10<sup>6</sup> cfu/g, 2.85x10<sup>6</sup> cfu/g, 3.01x10<sup>6</sup> cfu/g and non-dumpsites (NDS) were 1.28x10<sup>6</sup> cfu/g, 1.25x10<sup>6</sup> cfu/g, 2.85x10<sup>6</sup> cfu/g, 2.42x10<sup>6</sup> cfu/g. The total fungal counts in the dump sites (DS) were 5.21x10<sup>3</sup> cfu/g, 4.64x10<sup>3</sup> cfu/g, 2.84x10<sup>3</sup> cfu/g, 4.42x10<sup>3</sup> cfu/g and non-dump sites (NDS) were 3.68x10<sup>3</sup> cfu/g, 2.22x10<sup>3</sup> cfu/g, 3.21x10<sup>3</sup> cfu/g, 2.82x10<sup>3</sup> cfu/g. Some of the bacteria isolated were *Bacillus spp.*, *Escherichia coli*, *Micrococcu spp.*, *Pseudomonas spp.*, and *Staphylococcus spp.* These microbes produce enzymes like DNase, Hyluronidase, staphylokinase, staphylolysin, among others that may help to degrade organic materials at dump sites (Williams and Hakam., 2015). Bacteria periodically found in soil including enteric pathogens such as *E. coli* pose serious health hazards for people, The higher the number of pathogenic bacteria in soil, the greater the likelihood of human and animal infections. Although the role of soil as a reservoir of certain bacterial pathogens is not a question, recent findings show that soil may have a larger role in the transmission of enteric diseases than previously thought (Epstein, 2002). Fungal species like *Aspergillus candidus*, *A. flavus*, *A. fumigatus*, *A. nidulance*, *A. niger*, *Mucor varians*, *Rhizopus nodosus* and *Yeasts* were isolated from all the dumping sites. *Cunninghamella echinata* is confined to dump site-I. *Phoma humicola* was restricted to dumpsite III. *Penicillium citrinum* was common at dump site I and IV, where as *Penicillium funiculosum* found in dump site II and IV. Fungi, especially *Aspergillus spp.* secrete mycotoxins that are poisonous to health when contacted (Onuegbu, 2002). The decomposition of organic matter is brought about by various microbial community (Bollen, 1985) which may cause problems to human beings. The various levels of biodegradation are due to the activities of fungal enzymes such as  $\alpha$ - endogluconase and  $\beta$ -glucosidase *etc* (Fahnrich *et al* ,1981).

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