MICROBIAL CHARACTERIZATION OF SOLID WASTE

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ABSTRACT

Segregation of solid waste at source is not a common practice in Bangladesh. Non-segregation of solid waste creates threat to surrounding environment. To identify the possible threat, leachates were collected from different sources viz. household bin, Dhaka city corporation (DCC) bin, hospital waste bin and dumping ground; and analyzed for microbial characterization. High concentration of total coliform ($9.0x10^4$ -$1.1x10^8$ CFU/100mL) and fecal coliform ($5.0x10^4$-$6.0x10^7$ CFU/100mL) were obtained in all samples. Nematodes were found in DCC bin (5200 No/L) and dumping ground (5600 No/L) samples. Protozoa and *Salmonella spp/Shigella spp.* were not found in any sample. However, *Pseudomonas spp* was present in the leachates of household bin, DCC bin and dumping ground.

KEY WORDS

Segregation; Microbial characterization; Leachate; Nematode; *Salmonella spp/Shigella spp.; Pseudomonas sp.*

1 INTRODUCTION

Solid waste is an environmental concern of urban as well as rural life of Bangladesh. Household solid waste and medical waste generation rate in urban area is 0.5 kg/person/day [1] and 0.3 kg/bed/day [2] respectively, of which 5-10% is infectious. Traditional waste management is a common practice throughout the country. About 42% of household waste remains uncollected in DCC. Pathogenic contamination from wrong management practice may create severe threat to human health. Most of the medical waste discharges in the dumping ground without sterilization.

One of the main health and environmental problem arises from uncollected solid waste include, smell, disease vector, closed drainage system, rats, mosquitoes breading ground and flies which have both direct and indirect health impacts [3]. Poor collection, indiscriminate disposal of waste leads to breeding of insects, rodents, and other pathogens which in turn leads to spreading of typhoid, malaria, dysentery, diarrhea, worms infestation and other contagious diseases [3, 4]. It provides food and breeding sites for insects and rodent diseases vector. Even feeding animal on solid waste can be a dangerous to human health, because it spoils the human food chain for transmitting disease. It is estimated that about 5 million people die each year in developing countries from health problem arising from inadequate collection and disposal of solid waste [3].

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Most of the developing countries solid waste management (SWM) services don't include separation at source. Waste streams are therefore mixed sometimes with fecal matter especially, where sanitary facilities are lacking i.e. slum settlements. A high percentage of waste workers and people living near or disposal sites are infected with gastro-intestinal parasites, cholera, yellow fever and plague etc. [3].

Degradation of waste material starts quickly due to high temperature, humidity in tropical country like Bangladesh. Composting of MSW needs a favorable condition like temperature, moisture content, humidity, etc. Too high temperature (>70°C) destroys microorganism population which needs for the degradation of food materials. 50-60° C temperature is ideal. It can be controlled through mixing and aeration. Optimum pH range is 7-8 and moisture content of 50 to 70% is ideal. Too low inhibits and too high - anaerobic conditions develop. By knowing microbial status of municipal solid waste, one can take preventive measures accordingly during composting. Microbial disinfection capacity of municipal solid waste (MSW) composting studied by De´portes et al. [5].

Numerous pathogens (fungi, virus, bacteria, helminthes, and protozoa) can be found in sewage sludge and in municipal solid wastes [6, 7, 8, 9, 10]. There are a number of disinfection procedures [11] are available. Each of the procedures has some advantages over disadvantages too. Suitable technique should be selected according to need of the work.

In the present study, three pathogenic micro-organisms were chosen. *Salmonella* and *Shigella* have often been studied because they are occasionally present after fecal contamination [8, 12].

2 OBJECTIVES

General objective of the research is to see the presence of microbes and their population in the leachates of sold waste in some disposal station. However, specific objectives are:

- to see the status of total coliform and fecal coliform in the leachate.
- to see the presence of *Salmonella spp/Shigella spp., and Pseudomonas spp* in the leachate.
- to see the status of nematode and protozoa in the leachate.

3 SAMPLE COLLECTION AND ANALYTICAL PROCEDURES

Biodegradable solid waste degrades after few hours (4-6) of disposal. So the leachates were collected within 24 hours of waste disposal except dump site. Sampling stations were house hold bin, DCC bin, dump site and hospital ground. Leachtes were collected in pre-sterilized vial at ambient condition and stored below 4°C before analysis. Then the samples were diluted and analyzed. The media used here mFC agar media. The incubation was done at 37°C for TC and 44°C for FC. The characteristics colonies were counted and identified using standard procedures described by APHA [13].

4 RESULTS AND DISCUSSIONS

Leachates from household bin, DCC bin, dump site and hospital ground are not free from coliform (TC) and fecal coliform (FC) (*Table 1*).

Table 1. Analysis for total coliform and fecal coliform in the leachate of solid waste.

Sample ID	Unit	TC	FC	Ratio (TC/FC)
House Hold Bin	CFU/100mL	$6.5x10^6$	$2.4x10^6$	2.708
DCC Bin	CFU/100mL	$1.1x10^8$	$6.0x10^7$	1.833
Dump Site	CFU/100mL	$5.0x10^7$	$3.0x10^7$	1.666
Hospital Ground	CFU/100mL	$9.0x10^4$	$5.0x10^4$	1.800

TC = Total Coliform and FC = Fecal Coliform; Source: Field Survey 2006

Bangladesh standard for TC and FC in drinking water is almost zero [14]. Presence of bacteria in water may increase many fold within favorable tropical condition exist in Bangladesh. High TC and FC were obtained in all samples compared to drinking water standard. Accidental or incautious exposure of TC and FC from leachates of different sources will create threat to surrounding environment. Therefore, it has to be taken mitigation measures for contamination free water.

Samples from DCC bin contains highest amount of TC $1.1x10^8$ CFU/100mL. Also FC is obtained in DCC bin $6.0x10^7$ CFU/100mL. This is due to longer residence time of degraded waste in the DCC bin and favorable fission condition. Residence-time both household and DCC bin must be shortened to check growth of pathogens. Biodegradable waste is to be collected from household for disposal within six hours by community based organizations (CBO).

Seasonal variation was not studied because there were no seasonal variations in the MSW microbial population between the spring and the summer [5]. Seasonal variation in the microbiological composition of human feces has already been described [15]. However, fecal contamination of MSW seemed to be mainly of non-human origin. The fecal coliform/fecal streptococci ratio (FC/FS) is thought to be an index of the fecal contamination origin [16]; an FC/FS above 4 may characterize human feces while a value below 0.6 is characteristic of other warm-blooded animals (i.e. about 0.3 for dogs and 0.02 for cats) [16]. In this study, the ratios of TC/FC were 1.67 to 2.71 according to the run, suggesting that human fecal contamination was relatively moderate. However, this result must be considered carefully, as the FC/FS ratio is more suitable in fresh waste because die-off rates are different in both groups. In this study, the time between waste being collected and being sent could reach one or two days. A low human fecal contamination is also supported by other microbial analyses.

Table 2. Analysis for presence of Salmonella spp/Shigella spp., and Pseudomonas spp in the leachate of solid waste.

Sample ID	*Salmonella spp./ Shigella spp.*	*Pseudomonas spp.*
House Hold Bin	Absent	Absent
DCC Bin	Absent	Present
Dump Site	Absent	Present
Hospital Ground	Absent	Absent

Source: Field Survey 2006

*Salmonella spp/Shigella spp.*was absent in the samples of collected leachate of solid waste. No *Shigella* were found in this study because they are linked to human and higher monkeys' digestive tracts and are only occasionally found in other mammalian species (e.g. dogs).

Pseudomonas spp. was not found in household waste bin and hospital waste leachates. Presence of *Pseudomonas spp.* in DCC bin and dump site indicating alarming situation.

Table 3. Analysis for nematode and protozoa concentration in the leachate of solid waste.

Sample ID	Unit	Nematode	Protozoa
House Hold Bin	No/L	0	0
DCC Bin	Larvae/L	5200	0
Dump Site	No/L	5600	0
Hospital Ground	Larvae/L	0	0

Source: Field Survey 2006

In *Table 3* it has been shown the concentration of nematode and protozoa of different leachate sources. Nematode concentration is found highest (5600 No/L) in dump site. However, nematode concentration is absent in house hold bin and hospital ground. No protozoa are found in any sample source. Contaminated soil and water is the source nematode and protozoa.

Hospital falls in the Red category project. It needs Initial Environmental Examination (IEE), Environmental Impact Assessment (EIA), Environmental Management Plan (EMP) and continuous monitoring. Before establishing hospital, it requires clearance from Director General (DG), Department of Environment. Most of the hospital wastewater including solid waste is discharged without any treatment [2]. This is a clear violation of existing environmental law [17] of Bangladesh. According to ECA 1995 every hospital should have a waste treatment plant and each one should submit status report to Department of Environment twice or thrice each year.

5 CONCLUSIONS

Bangladesh standards for Total Coliform (TC), Fecal Coliform (FC), *Salmonella spp/Shigella spp. ,and Pseudomonas spp,* nematode and protozoa in the leachate should set immediately. Contaminated leachate creates threat to nearby water bodies as well as human health. Solid waste separation at source may reduce contamination threat. Extensive campaign for leachate contamination is required for the awareness of city dwellers, vegetable and fruit grower.

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