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STUDY OF PHYSICAL COMPOSITION AND BACTERIOLOGICAL ANALYSIS OF SOLID WASTE OF KATHMANDU CITY

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ABSTRACT

Solid waste is a pollutant of soil, air and water with important implication for public health. It is also aesthetic or visual polutant (IUCN, 1991). It is often called third pollution after water and air. The present study gives an information about the quality and quantity of solid waste at different sites of Kathmandu city. It also highlights the impact of solid waste on environment and human health.

During this study, the quality of solid waste was found to be of heterogeneous type. During winter season biodegradable and non-biodegradable substance varies from 74.76% to 83.85% and 16.15% to 25.24% respectively. Whereas during summer season it was variable from 76.22% to 85.72% and 14.28% to 23.78% respectively. The pH value obtained varied from 5.88 to 8.35 during winter season and 6.02 to 8.85 during summer season. In both seasons the temperature of solid waste was found to be greater than that of atmospheric temperature. The moisture content obtained varied from 39.76% to 42.85% during winter season and 31.87% to 68.95% during summer season.

Bacteriological study isolated different types of organisms of which 37 species were of Enterobacteriaceae group and *Bacillus* and *Pseudomonas species*. The study also reflects the direct and indirect effect of solid waste on the human health and their environment.

INTRODUCTION :

Urbanization, modernisation, industrialisation and changing consumption patterns of Kathmandu city has increased the proportion of solid waste. Uncontrolled solid waste increases water, air and soil polution which is very serious to the human

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health and environment. The improper handling of solid waste creates potential hazards to public health and environment including proliferation of insects, flies and rodent vectors of diseases (IUCN, 1992). In the city area, the environmental damage is mainly caused by the solid wastes which have created ugliness in the streets and important open spaces and the destruction of the natural beauty of the country. Thus solid waste has been a major problem in Kathmandu city. The sanitary condition of Kathmandu is very poor, due to which various types of serious diseases are common in the city. Hence the proper management of solid waste is very essential forhaving a good environment.

This study was focused on :

Survey of solid waste of Kathmandu.

Survey of seasonal variation of composition of solid waste,

Study of biodegradable and non-biodegradable components of solid waste,

Study of physical parameters of solid waste.

Bacteriological study of solid waste.

MATERIALS AND METHODS :

To study the degree of pollution, different places were chosen according to the locality basis namely, Bhotahity (S_1), highly dense populated area was chosen as central vegetable and fruit market in the centre of Kathmandu, Kalimati (S_2), was chosen as vegetable and fruit stock market area, New Road (S_3), was chosen as one of the major urban area and market area and Teku (S_4) was chosen as central collection of solid waste. These four places are highly dense urban areas.

Sterile plastic bags were used for the sample collection. The pH was tested by using electric pH meter. Temperature of the sample was measured on the site by dipping the thermometer into the sample upto 6 inches. Moisture content was calculated by taking the weight before and after drying in an oven using desiccator.

In the bacteriological study, different types of media and various techniques were used for the enumeration and isolation of bacteria. different types of media as basal, selective, enriched and differential media were used and biochemical tests were performed for the identification of isolated bacteria (Mackie and MacCarney. 1989).

RESULT :

During the study, in winter season (Jan, Feb, March), the waste of S_1, S_2, S_3 and S_4 samples had pH 6.98, 5.88, 7.22 and 8.35, respectively. Whereas during summer season (May, June) it was found to be 7.58, 6.02, 7.97 and 8.85, respctively. During winter season the temperature of S_1, S_2, S_3 and S_4 samples were found to be 14.3°c, 32.3°c, 15.5°c and 37.0°c, respectively. Whereas during summer season it was found to be 28°c, 39.66°c, 24.78°c and 48.6°c respectively. during winter season the moisture content of S_1, S_2, S_3 and S_4 samples were found to be 40.60°c, 39.76°c, 42.85°c and 34.90°c respectively. Similarly during summer season it was found to be of 38.78°c, 59.70°c, 68.95°c and 31.87°c respectively.

Generally solid waste was divided into two categories.

1. Biodegradable substance (BD)
2. Non-biodegradable substance (NBD)

The composition of biodegradable and Non-biodegradable substances in two different seasons are given in Table 1.

Table 1.

Composition of solid waste in two different seasons.

Location	Winter Season (Jan, Feb, March)		Summer Season (May, June)	
	BD (%)	NBD (%)	BD (%)	NBD (%)
S_1	76.75	23.25	77.29	22.71
S_2	83.85	16.15	85.72	14.28
S_3	74.76	25.24	76.22	23.78
S_4	79.94	20.06	81.85	18.15

where, S_1 : Bhotahity, highly dense populated area and is the central vegetable and fruit market in the centre of Kathmandu.

S_2 : Kalimati, vegetable and fruit stock market.

S_3 : New Road, one of the major Urban area and market area.

S_4 : Teku central collection of solid waste.

Table 1, clearly indicates that the highest amount of biodegradable substance (83.85% during winter and 85.72% during summer season) and non biodegradable substance (25.24% winter season and 23.78% summer season) were obtained from the sample of Kalimati and New Road respectively. The biodegradable substance obtained from Bhotahity and Teku were 76.75% and 79.94% during winter season and 77.29% and 81.85% during summer season respectively. The non-biodegradable substance obtained were 23.25% and 20.06% during winter season and 22.71% and 18.15% during summer season resectively.

Solid waste is loaded with many pathogenic and non-pathogenic bacteria (Rao, 1995). During the study a number of pathogenic and non-pathogenic bacteria were isolated and tabulated in Table 2 and Table 3.

Table 2

Total number of organisms obtained from pour plate method.

Location	No. of total bacterial cell/gm	No. of Entero-bacteriaceae cell/gm
Bhotahity	1.5×10^8	4.5×10^7
Kalimati	5.5×10^7	2.5×10^5
New Road	9.8×10^7	2.0×10^7
Teku I	1.6×10^8	1.4×10^7
Teku II	2.8×10^8	9.5×10^7

Table 2 indicates that the highest number of total bacterial cell and Enterobacteriaceae cell were obtained from the sample of Teku 2 where as least number was obtained from the sample of Kalimati. The total bacterial cell varies from 5.5×10^7/gm to 2.8×10^8/gm where as the Enterobacteriaceae well varies from 2.5×10^5/gm to 9.5×10^7/gm.

Table 3

Types of organisms isolated from the sample of different sites of Kathmandu city.

Location	Enterobacteriaceae gp.	No. of colonies/ gm	Other than enterobacte riaceae	No. of colonies/ gm
Bhotahity	Citrabacter diversus	4×10^1	Bacillus sps	8×10^1
	Enterobacter aqqlomerans	2×10^3	B. cereus	2×10^3
	E. clocae	3×10^4	Pseudomonas sps	8×10^4
	E. gergoviae	2×10^4	Streptococcus faecalis	3×10^3
	E. hafniae	2×10^4	Alakaligen faecalis	3×10^3
	Escherichia blattae	7×10^2		
	E. coli	9×10^7		
	Klebsiella ozaenae	5×10^5		
	K. pneumoniae	8×10^4		
	Proteus vulgaries	6×10^5		
Kalimati	C. fruendii	1×10^3	Bacillus sps	3×10^7
	Edwardsiella hoshine	2×10^3	Pseudomonas sps	2×10^4
	E. gergoviae	2×10^3	Ps. auriginosa	3×10^5
	E. agglomerans	8×10^3	Ps. fluorescens	3×10^4
	E. intermedium	2×10^3	Alkaligen faecalis	2×10^4
	Erwinia herbicola	5×10^3		
	E, mallotivora	2×10^4		
	E. coli	4×10^4		
	Hafniae alvei	12×10^4		
	Klebsiella atlantae	3×10^3		
	K. edwardsi	5×10^4		
	K. oxitaca	1×10^3		
	S. typhi	5×10^3		
	S. paratyphi A	1×10^3		
	Serratia plunthica	3×10^3		
	S. rubedia	1×10^3		
New Road	C. diversus	3.4×10^1	Bacillus sps	1.5×10^7
	C. fruendii	7×10^4	Acenetobacter sps	4×10^3
	E. tarda	3×10^7	Straptococcus faecalis	7×10^5
	E. agglomerans	4×10^4	Yeast fission	2.8×10^4
	E. hafniae	3×10^4	(Schizosaccharo-	
	E. coli	8.3×10	mycetes sps)	
	K. ozaenae	9×10^7		
	K. pneumoniae	5×10^5		
	S. paratyphi A	5×10^4		
	Shigella dysentery	3×10^4		

Location	Enterobacteriaceae gp.	No. of colonies/ gm	Other than enterobacte riaceae	No. of colonies/ gm
Teku I	Cedecea lapagei	2×10^4	Bacillus sps	2.6×10^7
	Citrobacter amalonaticus	1.2×10^4	B. brevis	2×10^6
	C. fruendii	3×10^5	B. magaterum	4×10^5
	E. *aerogens*	3×10^4	Pseudomonas sps	9×10^5
	E. agglomerans	2×10^5	Ps. auriginosa	2×10^4
	E. blattae	2×10^4	Ps. flurorescens	1×10^5
	E. coli	9.2×10^5	Ps. pseudomallei	2×10^4
	P. mirabilis	3×10^5	Acenetobacter	3×10^5
	Salmonella 1	4×10^5	caleoaceticus	
	S. arizonae	6×10^5		
	S. typhi	1×10^5		
	S. flexnarey	4×10^4		
	Yersinia ruckeri	1×10^5		
Teku II	C. fruendii	3×10^4	Bacillus sps	6.5×10^7
	E. aerogens	2×10^5	B. brevis	4×10^5
	E. agglomerans	2×10^3	B. cereus	2×10^5
	E. hafniae	5×10^4	B. coagulans	2×10^5
	Erwinia herbicola	3×10^7	B. subtilis	3×10^5
	E. coli	9.8×10^5	Pseudomonas sps	2.2×10^7
	K. Pneumoniae	6×10^4	Ps. auriginosa	4×10^5
	Providencia alkalifaciens	2×10^7	Ps. pseudomelli	4×10^4
	Proteus myxofaciens	4×10^5		
	P. vulgaris	3×10^1		
	Salmonella sps	5×10^5		
	Shigella dysentery	4×10^5		
	Serratia marcences	5×10^5		
	Tauytmella ptyseas	1×10^4		

Table 3 indicates that 37 species of Enterobacteriaceae group, along with *Bacillus sps.* and *Pseudomonas sps.* were isolated from the different sites of solid waste of Kathmandu city. The highest number of Enterobacteriaceae cell, *Bacillus sps.* and *Pseudomonas sps.* were isolated from the sample of Teku II.

DISCUSSION :

The present study has been carried out to explore the physical and bacteriological composition of solid waste of different places of Kathmandu city. The city waste was found to be of heterogeneous type. The solid waste of Kathmandu occupied 79.5% biodegradable substance and 20.5% non-biodegradable substance. The amount of biodegradable substance was found to be greater during summer season than during winter season. The pH of the city waste was found to be 5.88 to 8.35 during winter season whereas it was 6.02 to 8.85 during summer season. The moisture content was found to be of 44.6%. The temperature of solid waste of all samples were found to be greater than the atmospheric temp.

In the bacteriological analysis of solid wastes, different types of organisms were isolated as Enterobacteriaceae group (eg. E. coli, K. pneumoniae, C. fruendii, Proteus sps., Salmonella sps., Shiogela sps., Edwardsiella sps. etc.), Bacillus sps., Pseudomonas sps. The highest number of organisms were isolated from the sample of Teku II (Central collection of waste site). These organisms belong to the pathogenic group and cause various types of serious infectious diseases as gastroenteritis, typhoid fever, Urinary tract infection, respiratory tract infection, eye infection, skin infection, food poisoning etc. There are a number of possibilities to contaminate food and water with these bacteria (WHO, 1998). This creates public health problem in Nepal. Water pollution is turning Kathmandu's famous rivers into sewers. Rivers and other surface water bodies are important for recreation, irrigation, fisheries and hydropower generation. If the solid waste containing heavy metals are discharged into these sources, these compounds become water soluble, non-degradable and strongly bonded in the body of aquatic animals. Humans who eat these infected animals may have a fatal desease in the long run. For example, cadmium deposited in the human kidneys, damage the kidney. Mercury afects neurological system. Thus clean and safe water is a basic need for healthy living. UNICEF had reported that water borne diseases are of major threats to health in a world of developing countries. In Nepal water and food borne disease belongs to the first rank (Health Information Bulletin HMG, 1990). In Nepal more than 70 percent of diseases are related to basic water supply and sanitation (Sharma, 1993). According to the record maintained by Public Health Deprtment, HMG Nepal in 1990, 43000 children died every year in Nepal due to gastroenteritis related to contaminated water (Shrestha, 1994). The presence of coliform bacteria in drinking water may indicate the bacterial infection causes water borne diarrhoeal disease (Finegold & Baron, 1990).

On the other hand, this study suggests that the improper handling of solid waste creates potential hazards to public health and environment including prolifferation of insects flies and rodent vectors of disease. It also causes air and soil pollution which are very serious problems to the human health and environment.

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