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MICROBIAL ECOLOGY AND TREATMENT OF MUNICIPAL WASTES AT MARGAO - GOA.

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Current investigations have been carried out to improve the methods of garbage disposal at Margao, Goa. Samples were tested for the presence of microorganisms having different metabolic activities. Organisms capable of degrading Carbohydrates, proteins, lipids and also some with phosphate solubilising activity were isolated and then identified. The activity of certain enzymes was determined. Field trials were carried out using microbial inoculants on garbage heaps with a view to convert this garbage into compost. The microorganisms showing optimal enzyme activity were inoculated into heaps and allowed to remain for a month. The conversion of the garbage heaps into compost was monitored by periodic biochemical estimations.

Garbage production is an integral part of the growth of societies and civilizations. For the healthy development of any community, it is imperative that people give due attention to handling and treatment of solid wastes. In the form of garbage, it is not only a source of nuisance but poses a threat to the healthy development of the community. In recent years more and more people now realize that garbage is a misplaced resource and not a "Waste of high nuisance value."

Garbage disposal has been problematic, due to the callous attention afforded to the scientific methods needed to solid waste management techniques. Most often garbage has been unscrupulously strewn in pits, bins and on dumping sites untreated and unattended. Thus garbage instead of being a source of wealth posed a serious threat of disease due to spread to pathogenic microorganisms by animals, birds and the seepage of dump leachates into the ground water bodies (1).

EXPERIMENTAL RESULTS & DISCUSSION

Garbage samples are collected in alcohol sterilized polythene bags to avoid external contamination. About 100 gms of garbage samples were collected using shovel. Tests were done within a week after collection. Till then they were store at 4°C in the refrigerator.

Isolation of Microorganisms : 1 gram of sample was dissolved in 100 ml saline and streaked on respective agars.

Cellulose degraders : Carboxy methyl cellulose agar (CMC) (2)
Starch degraders : Starch agar (3)
Protein degraders : Milk agar (4)
Lipid degraders : Gorodkwas tributyrine agar (5)
Phosphate sollubilizers : Hydroxyapatite agar (6)

Table 1 List of the organisms identified for degradation of different substances

Cellulose degraders	Starch degraders	Protein degraders	Lipids degraders	Phosphate degraders
C1: *Cellulomonas* sp	S1: B. *subtilis*	M1: B. *cereus*	L1: M. *lylae*	P1: B. *subtilis*
C2: *Cellulomonas* sp	S2: X. *fragariae*	M2: M. *lyllae*	L2: P. *aeroginosa*	P2: B. *pollymyxa*
C3: *Cellulomonas* sp	S3: A. *globiformis*	M2: M. *nicotianae*	L3: P. *chlororaphis*	P3: Pr. *myxofaciens*
C4: *Cellulomonas* sp	S4: P. *stuzeri*	M4: P. *pseudomallei*	L4: F. *spiritivorum*	P4: P. *aeroginosa*
C5: B. *circulans*	S5: B. *polymyxa*	M5: X. *campestris*	L5: F. *multivorum*	P5: A. *pascens*
C6: C. *freundii*	S6: B. *macerans*	M6: F. *balustinum*	L6: Pr. *vulgaris*	P6: P. *mallei*
C7: S. *liquefaciens*	S7: X. *axoonopodis*	M7: Pr. *myzofaciens*	L7: P. *stutzeri*	P7: Pr. *vulgaris*
C8: X. *campestris*	S8: F. *aquatile*	M8: S. *liquefaciens*	L8: S. *liquefaciens*	P8: S. *liquefaciens*
	S9: P. *mallei*	M9: Ch. *violaceum*	L9: Pr. *mirabilis*	P9: X. *campesirts*
	S10: A. *pascens*	M10: P. *chlorooraphis*	L10: Pr. *myxofaciens*	
	S11: P. *pseudomallei*		L11: V. *fluvialis*	
	S12: P. *saccharophila*		L12: S. *marcescens*	
	S13: F. *balustinum*		L13: V. *gazogenes*	
	S14: X. *campestris*			

B = *Bacillus*. C = *Citrobacter*. S = *Serratia*. X = *Xanthoomonas*. A = *Arthrobacter*. P = *Pseudomonas*.
F = *Flavobacterium*. Pr = *Proteus*. V = *Vibrio*. = *Micrococcus*. Ch = *Chromobacterium*

The organisms were identified on the basis of Morphological and Biochemical studies using Bergey's Manual of Determinative Bacteriology (7,8). Table 1.

Organisms showing highest catabolic activity were inoculated separately into 1000 ml nutrient broth in 2000 ml conical flasks. Incubate at room temperature on shaker for 48 hours. At the dumping site Sonsoddo, 2 heaps of dimensions (1m x 1m x 1m) were made containing garbage. The test heap was inoculated with 5000 ml of the culture. Other heap was control. Mix the garbage well. The garbage was turned after every 2 days of hasten the process and also adequate moisture content was maintained by adding water. Sampling was done every week for laboratory analysis i.e. 0, 7, 14, 21 and 28 days. The Biochemical analysis for different nutrients were done. Around 20 gms of samples was taken from each heap for analysis (Table 2).

Table 2 Chemical analysis during composting

Time in days	Concentration mg/g garbage				
	Cellulose	Sugars	Protein	Phosphorous	Nitrate Nitrogen
0th day					
Inoculated	34	0.8	14.0	0.0625	0.035
Uninculated	33.4	0.75	14.5	0.0625	0.03
7th day					
Inculated	32.6	1.0	11.5	0.45	0.06
Uninculated	33.4	0.85	12.5	0.08	0.035
14th day					
Inculated	20.8	1.80	8.5	1.0	0.12
Uninculated	33.0	1.20	11.8	0.1	0.04
21st day					
Inculated	20.0	2.35	5.5	1.375	0.14
Uninculated	33.0	1.75	11.0	0.112	0.055
28th day					
Inculated	19.0	4.25	4.0	1.525	0.205
Uninculated	31.6	1.90	9.8	0.125	0.09

1. Updegraff method
2. DNSA method
3. FC reagent
4. Acid molybdate method
5. Phenol disulphonic acid

Table 3 C/N ratio of compost

Time in days	% Organic Carbon	% Nitrogen	C/N Ratio
0 day			
Inculated	47.2	0.251	188
Uninculated	47.2	0.251	188
7th day			
Inculated	32.4	0.296	109.6
Uninculated	46.0	0.253	182.1
14th day			
Inculated	17.0	0.308	55.2
Uninculated	40.8	0.267	152.9
21st day			
Inculated	9.9	0.325	30.5
Uninculated	25.4	0.269	94.6
28th day			
Inculated	9.4	0.372	25.3
Uninculated	17.4	0.278	62.7

The protein content, cellulose content and organic carbon contents were found to decrease rapidly in the test tub and heap as compared to the control. The reducing sugars, phosphorus content and nitrogen content were found to increase rapidly in the test as compared to the control. The C:N ratio of 30 was attained in a period of 21 days for the test whereas in the control it decreased very slowly. Since Goan garbage is 60-70 percent biodegradable, it could be used to prepare organic rich fertilizer which could be used on plants. This ideal of making a cheap and odour free fertilizer from garbage is a novel way using micro-organisms is very ideal for the Goan garbage. For many underdeveloped countries, unable to afford the western aids to agriculture, careful composting and return to soil of plant and animal wastes is the only present hope of improving crop production.

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