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Physical and Microbiological Characters of Kitchen and Garden Compost

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Abstract: The most concern environmental issues now a day are the disposal of solid waste. It has given rise to many environmental problems. This paper shows that composting is fundamentally a microbiological event that highly depends on temperature, moisture content, pH and oxygen. All these parameter maintained at their optimal value. The study was conducted on food, garden and yard waste. All the samples were collected manually. In this paper the purpose of study of composting is to outline the controlled process of biological maturity under aerobic conditions where the organic matter undergoes the decomposition to the material with small molecular chains, more stable, hygienic, humus rich and ultimately advantageous for the agriculture crops and for re-cycling of organic matter.

Keywords Organic matter, pH, Temperature, Moisture content, oxygen, and biological activity.

INTRODUCTION

As in many other developing countries, it has been identified that Municipal solid waste (MSW) is one of the main environmental issue in Pakistan which has granted proceed uncompromising environmental problem such as ground water contamination, air pollution, aesthetic view of area, deteriorate the quality of land and water body. From the waste number of toxic compounds are released in environment like

(Vocs), volatile organic compounds, carbon monoxide, nitrogen oxide and dust pollution[1]. Together with this when waste is burn dioxins are also emitted in the environment[2,3]. Therefore, organic waste should be segregated and treated appropriately. Long history has been present previously indicate the municipal and agriculture waste to maintain soil fertility.

Composting now sound like a environmental waste treatment technology, Hence their interest in increase exponentially because of low cost and less negative impacts[4-6]. Leaves, animal manure, paper products, sewage sludge farm wastes and domestic wastes mostly used in composting [7,8].Compost can be believed as a much-needed soil conditioner with effective growth[9,10].Harmful compounds are liberated into the Composts can protect plants from soil [11] or seed borne pathogens[12] . The use of composting also improves the soil structure, aeration process, crop yield and water holding capacity[13]. This was scientifically proved by the study of Ghaly and Alkoaik[14],

MATERIAL AND METHODS

Lay out of Bin: The research study was conducted at the garden of Institute of Environmental studies (IES), University of Karachi at the month of February-May 2016; properly clean, aerated area is chosen and cleared for the composting pad. The experimental composting chamber is of 1.5 meter width, high and length.

Raw material for composting*:* For the preparation of composting two types of material required carbon rich material and nitrogen rich. Hence, to meet this requirement Kitchen waste used as a Nitrogen source and Garden waste used as a carbon source. For the growth of microbes moisture content is maintain up to 50-60 % during the whole period of study. The equal amount of both waste added for composting.

Quality of water: To keep up the moisture level in composting Bin normal water was used. The samples of water were examined for pH, total suspended solids (TSS), total dissolved solids (TDS) hardness and turbidity. For pH and turbidity Hanna portable pH meter (HI98107) and EUTECH meter (Model No. TN-100) used respectively. Gravimetric method was employed for TDS (APHA 2002)[15].Hardness was determined by $CaCO_3$ (EDTA titrimetric method).

Composting parameters: The total initial organic wastes used for composting and final finished compost were calculated by using the scientific balance. The composting material was properly maintained and water is periodically added to maintain the moisture content at 40 -50 %.Temperature of the composting material was monitored after every week with the help of thermometer inserting in compost pile. Aeration in the pile was done manually by turning the waste as it is necessary for the aerobic microbes to carry out their microbial activity.

Microbiological study: One gram of sample of compost were then subjected to vigorous vortex mixing for 60 seconds, ultra sonication for 30 seconds, followed by further vortex mixing for 15 seconds. Five-folds dilutions in phosphate-buffered saline (PBS) were prepared and 0.1ml of appropriate dilutions of 10-3 and 10-5 were spread onto the plates of following media; Mac Conkey's agar; for Enterobacteria, Cetrimide agar; for pseudomonas,Sabouraud's dextrose agar (SDA) are used for fungi isolation.

Isolation period: These plates were then incubated aerobically for 24-48 hours and the plates of SDA were further incubated for 48 hours to culture fungus. Predominant colonies were identified in each plate

and their morphological characteristics were studied in detail so as to determine which type of colony belongs to which genera.

RESULT AND DISCUSSION

During the composting organic matter undergoes the microbial degradation and produces the stable end product carbon dioxide, water, heat and humus. Atmospheric Temperature and temperature of the waste are calculated periodically after every week, by inserting the thermometer in waste pile as it, the temperature varies between 45 to 50 °C as it is very important for composting to know the microbial activity. The temperature must not be exceeded above 65°C because many useful microbes will be killed and rate of decomposition will be decreased. For that purpose to maintain the compost pile temperature aeration has been done the variation in atmospheric temperature and compost pile temperature is just because as the organic matter decomposes it releases heat. As it shows in **table 1.1 and fig 1.1**

Table 1.1 . Temperature Variation

DATE	Feb	Mar	Mar	April	May
TEMPERATURE	30°C	32°C	32°C	36°C	37°C

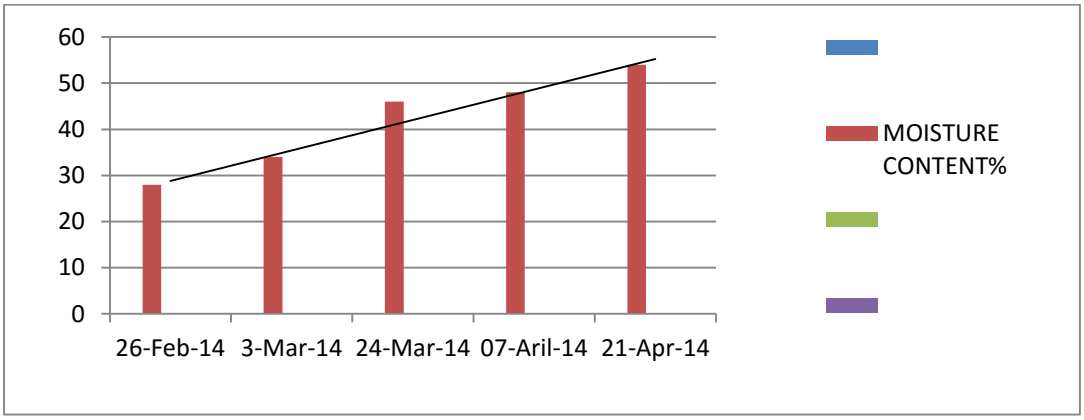

Figure 1: Graphical representation of composting water content

As composting is aerobic process, so for successful composting Oxygen is very fundamental element. The atmosphere consists of the 21% of oxygen and aerobic microbes survive as low as 5% so for composting 10% of oxygen is considered optimal. When the bacteria and fungi decompose the organic matter, organic acid is released. The pH and microbes has inverse relation. As the pH decreases the growth of the fungi increases

If the process becomes anaerobic, it will disturb the optimal pH value which is ranges between 5.5-8.5 and limiting the microbial activity. In order to maintain the pH, the aeration will be done. **In Table 1.2**

and **Figure 1.2** shows the pH of the compost pile which is calculated periodically after every 13 days by dilution process.

Table1. 2: pH variation

DATE	26-Feb-14	3-Mar-14	24-Mar-14	07-Apr-14	21-Apr-14
pH	7.8	7.20	6.9	6.6	6.4

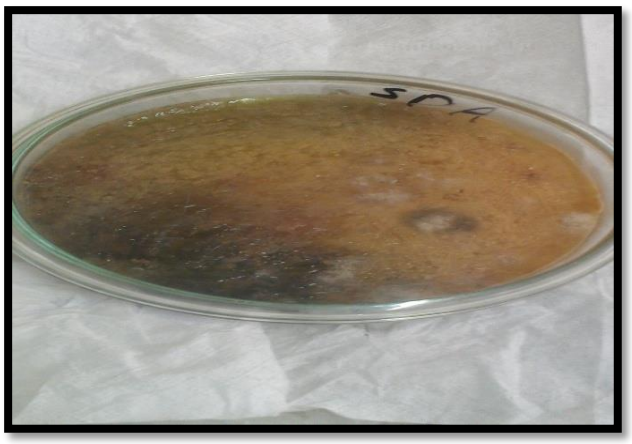

Figure 2: Fungal isolation on SBA media

Water is essential life component of active compost microorganisms because

- It exchanges the nutrient through cell membrane
- All the chemical reaction occur in the presence of water

Optimal moisture content of the compost is 40-60%.if it increases above 65%than anaerobic condition will developed and if it is decreased below 40% than it effect the microbial activity. Naturally Moisture content is decreases during the composting process and will affect the biological activity. The water used for the compositing maintain are show in table 1.6 when this situation is reached add more water to maintain optimal condition. Moisture content was periodically monitored after every 13 days as it shows in T**able 1.3 and Figure 1.3**

Table 1.3: Moisture content variation

DATE	26-Feb-14	3-Mar-14	24-Mar-14	07-Apr-14	21-Apr-14
MOISTURE CONTENT%	28	34	46	48	54

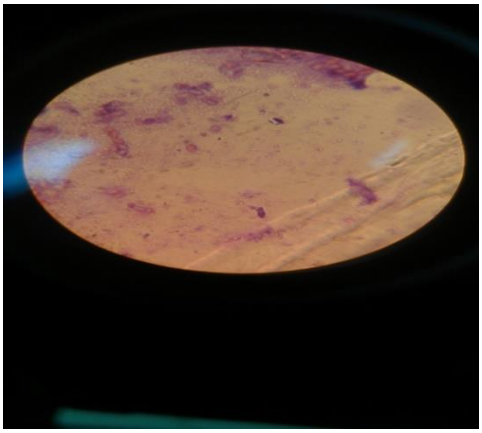

Figure 3: Bacteria colonies under microscope

The essential elements required for the bacterial decomposition are carbon and nitrogen. From the composting point of view Carbon/Nitrogen ratio is very important. Carbon is a source of energy and Nitrogen is fundamental component of protein, nucleic acid, enzymes which are necessary for cell growth and function. Usually for the composting the ideal Carbon/Nitrogen ratio is to be 30:1.To obtains this ratio organic material is added in appropriate quantity. The ratio gradually decreases during the composting from 30:1 to 10-15:1 at the final product this is because, microorganisms consumed the two-third of carbon of organic compound and the rest is incorporated along with the Nitrogen into the microbial cell. From the compost sample carbon was calculated by combustion process and nitrogen was calculated from the kjendhal method. **Table 1.4 and 1.5** shows the carbon/Nitrogen ratio of browns and greens waste respectively.

Table1.4: C: N of Browns

INGREDIENTS	WEIGHT	CARBON%	NITROGEN%	C:N
Straw	10kg	75	1	58:1
Grass Clippings	4kg	20	1	
Dry leaves	6kg	55	1	

Table1.5: C: N of Greens

INGREDIENTS	WEIGHT	CARBON%	NITROGEN%	C:N
Fruit Scrap	55kg	35	1	30:1
Vegetable Scrap	25kg	20	1	

The total Carbon/Nitrogen ratio of browns and greens were 38:1.

Composting is mainly a microbial process, Composting passes through multiple stages and each stage is identified by different microbial group's activity the bacteria identify by the different media. Colonies of the most suspected micro-organisms like Enterococci, Staphylococci, Pseudomonas spp and fungi on Sabouraud's Dextrose Agar were observed on the media plates results are show in figure 2, and 3

Table 1.6: Characteristics of water

Parameters	**Value**
pH	7.2
Total dissolved solids (TDS) mg/L	250
Hardness (as CaCo3 mg/L)	182
Iron (mg/L)	0.6
Total coliform (/ 100ml)	3-9
Fecal coliform (/100 ml)	0

CONCLUSION

Compost is one of nature's best soil amendment and condition materials. It can be used as a substitute of commercial fertilizers. It is also one of the best waste management options. Transforming the solid waste into the compost of biodegradable fraction is one of the most valid methods of recycling. As it is a low energy consumption and low expenditure process so it is possible to sort out the solid waste at source of generation and collect the organic portion of waste for composting. The compost which is obtained from MSW and biodegradable waste, it doesn't contain the sufficient nutrient to use as a fertilizer. Quality of compost can be made better by adding more organic manure to use as a fertilizer

REFERENCE

1. G.K.Kannan, M. Gupta, J.C. Kapoor, Estimation of gaseous products and particulate matter emission from garden biomass combustion in a simulation fire test chamber.Atmos Environ 2004;38:6701–10
2. T Katami, A Yasuhara, T Shibamoto, Formation of dioxins from incineration of fallen leaf. Bull Environ Contam Toxicol 2004; 72:114–8.
3. M. Wevers, RD Fré, M Desmedt, Effect of backyard burning on dioxin deposition and air concentrations. Chemosphere 2004; 54(9):1351–6.
4. B Yvette, Guanzon, Robert J. Holmer. Composting of Organic Wastes: A Main Component for Successful, Integrated Solid Waste Management in Philippine Cities, 2000.
5. S.A. Twieb, R.A. Rahman and M.S Kalil (2011) A Literature Review on the Composting, International Conference on Environment and Industrial Innovation, IPCBEE, 2011, 12-124-127.
6. C. Coker,"Environmental remediation by composting," Biocycle,2006,47, 18-23, 2006
7. D. V Adegunloye, F. C. Adetuyi, F. A. Akinyosoye and M. O. Doyeni, "Microbial Analysis of Compost Using Cow Dung as Booster," Pakistan Journal of Nutrition,2007, 6, 506-610

8. J. A. Adeniran, L. B. Taiwo and R. A. Sobulo, "Effects of Organic Wastes and Method of Composting on Compost Maturity, Nutrient Composition of Compost and Yield of Two Vegetable Crops," Journal of Sustainable Agriculture, 2003,22, 4, 95-101
9. Z. He, X. Yang, B. A. Kahn, P. J. Stoffella, and D.V. Calvert, "Plant nutrition benefits of phosphorus, potassium, calcium, magnesium and micronutrients from compost utilization," in Compost Utilization in Horticultural Cropping Systems, Lewis Publishers, Boca Raton, FL, 2000, pp. 307–320.
10. F Gallardo-Lara and R. Nogales, "Effect of the application of town refuse compost on the soil–plant system: a review," Biol. Wastes, 1987, 19, 35–62.
11. M. Alvarez, S. Gagne, H. Antoun, "Effect of compost on growth promoting rhizobacteria," Appied Environmental Microbiology, 1995, 61, 94–199.
12. C. Schuler, J. Pikny, M. Nasir, and H. Vogtmann, "Effects of composted organic kitchen and garden waste on Mycosphaerella pinodes (Ber. Et Blox)Vestergr., causal organism of foot rot on peas (Pisum sativum L.)," Biological Agriculture Horticulture,1993, 9,353–361.
13. D.L Martin and G Gershuny, the Rodale Book of Composting: Easy Methods for Every Gardener. Rodal Press Inc. Washington D.C, 1993.
14. A.E Ghaly and F.N. Alkoaik, Effect of municipal solid waste compost on the Growth and production of vegetable crops.*American Journal of Agricultural and Biological Sciences*. , 2010, 5: 274–281.
15. APHA, Standard methods for the examination of water and wastewater. 2005, American Public Health Association Washington DC., USA, 2002.

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