Research Article

Assessment of Municipal Solid Waste Compost of Different Socio-Economics Groups of Peshawar City, Khyber Pakhtunkhwa, Pakistan

Oaj Khurshid[1]*, Naureen Aurangzeb[1], Ayaz Khan[1], Alia Naz[1], Abdullah Khan[1], Sobia Nisa[2] and Sehrish Sajawal[3]

[1]Department of Environmental Sciences, University of Haripur, Pakistan; [2]Department of Microbiology, University of Haripur, Pakistan; [3]Post Graduate College for Women Mandian, Abbottabad, Pakistan.

Abstract | An experimental study was piloted to evaluate the possibility of composting of source separated organic substance of municipal solid waste (MSW) produced in low, middle and high income areas of Peshawar having the a population more than 2 million. Outcomes of MSW investigation showed the occurrence of great proportion of Decomposable organic matter, adequate moisture content and C/N ratio. On windrow composting, not only the bulk of the waste was compacted but also formed a powdery earthy stinking soil-like, compost material. All valued factors in the compost samples were found to be within the acceptable limits set by international standard. The pH fluctuated between 7.5-8.1, moisture 35% and organic matter 43%, and has adequate quantity of plant nutrients C34%, N (0.06%), K (0.32%), P (0.004), Na (4.6%). The quality of compost could further be enhanced with the addition of yard waste or cow and poultry manure etc. For land reclamation or plant productions the use of compost may be supportive not only increase moisture holding capacity but also help to sustain soil conditioning. Composting through MSW could be introduced country wise as solid waste management option for the recycling and reuse of the organic remains.

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***Correspondence** | Oaj Khurshid, Department of Environmental Sciences, University of Haripur, Pakistan; **Email:** oaj.khurshid@gmail.com
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Introduction

As the population of Pakistan is increasing day by day so this quick rise is changing life style which is ultimately causing an intense increase in the production of Municipal Solid Waste. In developed nations both the domestic and commercial wastes being a part of MSW are accounts for a comparatively minor portion of total solid waste stream (Mendes et al., 2003). Numerous problems could be created to inhabitants with accumulation of a large quantity of waste. There is need to apply some effective approaches for suitable removal of (MSW). Due to microbial based aerobic method of compost preparation it is now considered to be environment friendly technique which could produce carbon-based fertilizer or soil conditioner and also decreases organic waste (Gajdos, 1989). Demonstrating composting procedure is the essential to understand the composting process control (Gautam, 2010). There have been various methodologies to study composting processes, over past years (Agamuthu et al., 2000; Hammeleres, 1993) measured development rates of microbes by using the monod equation to simulate the process of composting (Ahmed et al., 2007) emphasizing the physicochemical changes and thermodynamic which

occurs during preparation of composting (Gazi et al., 2007) established a vibrant simulation model to illustrate process of biodegradation during composting contains understanding of the biochemical and physical change taking place throughout the process (Hamoda et al., 1998; Wang, 2001). Technique of composting the MSW is being encouraged in several countries and using MSW compost found to be beneficial in the field by many scientists around the globe (John, 1997; Abigail, 1998; Pokhrel and Viraraghavan, 2005). Keeping in view the importance of MSW production in Peshawar city and excessive budget for its removal, the current research was carried out to point a suitable method for the management of MSW which is discussed in this paper.

Materials and Methods

The inquiry was conducted at Nuclear Institute of Food and Agriculture Tarnab Peshawar during the month Aug to Oct 2009 at ambient temperature ranging from 35 to 45°C. MSW was collected from different vicinities from city of Peshawar, indicating low, middle and high socio economic areas. The organic portion of MSW mostly contained kitchen waste, vegetable, fruit etc., were manually separated and windrows composting process was done. As per Jilani (2007) the percentage of organic waste was determined, produced at numerous income clusters (Jilani, 2007).

By weighing the total mass of organic portion used for composting and the end compost were calculated. During the preparation of compost all essential conditions were maintained as suggested by Gajalakshmi and Abbasi (2008). By rotating the waste manually mostly the aeration in the pile was provided. A manually separated heap of mixed MSW having the height of 4' and length as 8' was left on smooth ground for windrow type composting. This heap was watered frequently to keep50- 60% moisture level as rotated by hands in 3-5 days during the first six weeks of composting process. The moisture of waste was then allowed to drip from the week seven, when the decomposition of most of bio solids was attained. The whole procedure was finished in almost 8-9 weeks. After mentioned time period the compost without turning was further left for three more weeks. The end compost was weighed out after screening it. A sample of compost which was the representative of prepared compost was taken from the well-mixed compost mound further necessary physicochemical analyses. From different points i.e. bottom, surface, side and center of the compost heap, sub-samples of 250 g were taken. Physical parameters like pH, Electrical conductivity, was examined on a sample in water (1:5), with the help of TOC analyzer the organic carbon (TOC) was analyzed, by using spectrophotometer Phosphorus was determined and by flame photometer the concentration of Sodium and Potassium in the sample was estimated while Total Kjeldahl Nitrogen (TKN) was measured by (Ravindran, 2007).

Table 1: *MSW Composting in low, middle and high socioeconomic localities.*

S.No	Components	High%(by weight)	Middle %	Low %
1	Paper	10	8	6
2	Plastic / Polythenes	12	13	20
3	Fabrics	1.7	3.4	1.8
4	Rubbers	1.2	2.4	0.6
5	Metals	0.9	0.6	0.3
6	Glass	3.5	4.6	1.5
7	Food wastes	33	28.6	23.2
8	Soil	35.8	38	43.3
9	Miscellaneous	1.9	1.4	3.3

Results and Discussion

Occurrence of substantial quantity of biodegradable organic and inorganic materials in contrast of standard value (Zuccconi and Bertoldi, 1987) as presented in Table 1 and 2 evidently shows that the organic section of the garbage was greatly appropriate for the process of composting. Related interpretations have also made by various previous researchers (Khatib et al., 1990; Rathor et al., 2014). It was perceived throughout the process that the mixture quickly heated up, reaching at 48°C on second day of composting. By sustaining the temperature of 48 – 50°C for early 3 days of the practice, the frequency of rotating and mixing of the waste was augmented to attain an optimum level for microbial degradation temperature which is between 35- 40°C (Tchobanoglous et al., 1993; Babyranidevi et al., 2003; Xi et al., 2003). Throughout the sequence of current analysis, it was experienced that mass of waste was reduces more meaningfully during the first week. The reason possibly is the maximum microbial action during the first week. More than 70% weight loss noted while composting of MSW during summer

Table 3: *Comparative average values of pH, Organic matter (%dry basis) and moisture content of MSW Compost and Chemical fertilizer samples.*

S.No	Sample type	pH	Organic Matter	Moisture
1	MSW Compost (High income)	7.57±033	36±1.5	35
2	MSW Compost (Middle income)	7.61±028	45±1.22	39
3	MSW Compost (Low income)	7.59±053	43±1.6	27
4	Chemical fertilizer	6.85±0.12	35±0.73	0

Table 4: *Comparative average nutritional values C/N ratio of composts and Chemical fertilizer Samples.*

S.No	Sample type	C (% dry basis)	N (% dry basis)	C:N (total dry basis)	P	K	Na
1	MSW Compost (High income)	37	0.06	37:0.06	0.004	0.37	3.5
2	MSW Compost (Middle income)	36	0.04	36:0.04	0.006	0.33	4.5
3	MSW Compost (Low income)	33	0.09	33:0.09	0.004	0.31	4.4
4	Chemical fertilizer	21.00±0.69	0.87±0.08	26:57	0.73±0.22	0.17±0.03	0.24±0.03
5	MSW Compost Quality Standard	>24	>1.5	<26	No Specs	No Specs	No Specs

Table 2: *Average chemical composition of municipal solid waste.*

S.No	Parameters	Average values	Set Standard values for composting
1	pH	7.5	5.5-8.0
2	Moisture (% dry basis)	35	<50
3	Organic Matter (% dry basis)	43	>20
4	Nitrogen (% dry basis)	0.06	>0.6
5	Carbon (% dry basis)	34	30-40
6	C:N (Total dry basis)	40:01:00	20-50:1
7	Phosphorus	0.004	Not Specified
8	Sodium	4.6	Not Specified
9	Potassium	0.32	Not Specified

*Source: *Standard deBertolidi, M. Zucconin F. (1987) [21]*

season and it required only 4-8 weeks. After one week the earthy smell of the material clearly indicated that the compost has been developed (Norbu et al., 2005). During first week of process, it was observed that the weight loss gently become more distinct as microbial activity augmented to maximum. It was experienced that, the process of composting during the season of summer was completed almost within 4-6 weeks. During summer season decrease in weight was up to 70% similar result detected by Andrea et al. (1998). The separated compost samples were brought to laboratory to examine different parameters for example moisture, Organic matter and pH. In Table 3 and 4 recorded data clearly specifies that the samples which were examined are within the set international standard for quality compost. The identified organic matter was meaningfully high (39-47%) whereas pH values and C: N was more or less with in prescribed standards. Contents of Nitrogen were recorded relatively low in concentration. The volume of other nutrients of plants like Potassium (1.00-1.80%) phosphorus (0.42-0.85%) and Sodium (1.21-1.92%) were also lies within the satisfactory limits as approved for soil conditioning related experiments have also done by numerous other researchers (Van et al., 1997; Saidi ei al., 2008; Taiwo and Oso, 2004) With the addition of phosphoric acid, which is responsible to avoid extreme ammonia volatilization, the nitrogen deficit could be enhanced (Dinel et al., 2004)

Typical good class compost comprises of high nitrogen concentration normally but there is no precise value set for Potassium or Phosphorus. During the present study prepared MSW compost was found to be eco-friendly, good soil conditioner, inexpensive and finest as compare to Chemical fertilizer. Therefore, MSW compost use in soil of Peshawar city may improve the aeration, accumulation and water holding capacity also could help to prevent soil erosion, essential nutrient release and can also controls various disease caused by contaminated soil.

Conclusion

It can be concluded based on current investigation that municipal solid waste is appropriate for the pro-

duction of compost because MSW contains high proportion of organic matter which is biodegradable, adequate moisture content and C: N. However, by adding immunizing agent for example yard waste cow and poultry manure etc. in the municipal solid waste, the process of composting and quality of prepared compost could further be upgraded. Since Peshawar soil having high content of silt and sand which is erodible and capacity to hold water is also low beside this it is also having little organic matter and nutrient content essential for plant growth. So the introduction of good quality compost would be an asset to enhance the health of plants and soils in the long tenure. Lastly, it is concluded that compost a component for the reclamation of the economical is a valuable organic fertilizer, which can be adapted throughout the country to reprocess the organic remains as eco-friendly waste management option.

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Authors Contribution

OK planned the research, designed experiments, collected solid waste from different areas of city, analyzed data and wrote the manuscript. SN supervised and monitored the whole research process. SS and NA analyzed the results statistically and revised the draft. AK and AN supported in experimental work and writing the manuscript. AK provided technical input in every stage of planning and write up.

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