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Studies on Degradation of Organic Food Waste, Municipal Solid Waste, and Agriculture Waste from Kolhapur, Maharashtra, India

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ABSTRACT

Present study deals with different types of organic waste samples collected from different areas of Kolhapur city such as food waste, agricultural waste and municipal waste. Different organic waste samples were degraded with increase in retention time from 1 to 50 days. The parameters like pH, EC, Nitrogen, Phosphorous and Potassium were studied after every 10 days of interval. The results were interesting showing increased degradation activity by using microorganisms. It is also evident in the study that if less energy is available for growth of microorganism less microbial biomass is produced. The result suggests that food waste degradation shows decrease in nitrogen, potassium, and phosphorous whereas organic carbon, organic matter was also decreased. Agriculture waste degradation shows organic carbon, organic matter, nitrogen decrease and increase in phosphorus, potassium. Municipal solid waste degradation shows decrease in nitrogen, phosphorus and slight increase in potassium and decrease in organic carbon and organic matter

Key word: *Biodegradation, Kolhapur, Municipal Solid Waste (MSW), Food waste, Agriculture waste*

Introduction

Solid waste is garbage, refuse sludge from an Industries, effluent treatment plant and commercial complexes. Waste is divided in three states as solid, liquid and semisolid. Waste is classified as organic and inorganic waste; biodegradable organic waste is used for composting and land application while Municipal solid waste included all domestic and commercial waste. Organic Municipal waste included food, sewage, paper, sludge and yard waste, these wastes also contains plant and animal waste and domestic solid waste is waste from kitchen and community activities. Waste is generally collected from industry, commercial complexes, mining and agriculture in huge manner which has become a big problem recently.

Food waste is generated during food preparation in kitchen, restaurants, employee lunch rooms, college canteen, and institutional café, food as raw and cooked state is discarded. Food waste has odour emanation, toxic gas emission, vermin attraction and ground waste contamination. It is good source for energy production and waste stabilization (Sun –Kee *et al*., 2004).

Agriculture waste contains organic and inorganic material, it produced during many agriculture activities in the far such as seed growing, cutting, horticulture. Nursery and gardening also produce waste, Wheat straw, sugarcane straw, been stack is

also produced in large quantity as an agricultural waste. Agricultural waste like sugarcane leaves, soyabean straw, wheat straw and cotton stalked biodegradation is a severe problem in main agricultural developing countries and need a very crucial step to develop an approach to these wastes (Jeevan Rao, 2007).

Municipal solid waste is by-product of human activity; it contains paper, packing material, uneaten food, plastic material, bottles, clothes, furniture material. Municipal solid waste is became a problem today as space is not available for dumping of solid waste and it is slow to degrade due to different mixtures. Degradation of Municipal waste is key factor in control pollution especially in rapidly increasing areas. The leachates coming out from these wastes have organic matter, chemicals. Organic constituents picked up by dissolved salt. (Singh *et al*., 2012) Anaerobic digestion is good method for degradation of waste (Hilkiah *et al*., 2016). Anaerobic digestion technology is considered as one of the useful methods to trim down waste. It is not disabling and cost-effective to treat these industrial wastes in separate digesters of each plant rather to install a centralized treatment facilitates for all contaminated waste together. The development of predictive solid waste for the behaviour of municipal solid waste in continuous anaerobic processing will largely mitigate the numerous damages done to the environment by treatment especially when the process involves the release of gas that is an energy service (Hilkiah *et al*., 2016). Microbial degradation has lately emerged as a simple but proficient biotechnological tool for recycling organic wastes to generate better end product with the help of some specific group of decomposing bacteria (Indumati, 2017).

Materials and Methods

Collection of sample

Solid waste samples were collected from selected sites as canteen, dumping ground of Kolhapur, farmland in Kasaba bawada area of city. Samples used for analysis and study of degradation of food waste, municipal waste and agriculture waste. Food waste samples were collected from canteen near CFC building, Shivaji University, Kolhapur. Municipal solid waste sample were collected from dumping ground at Kolhapur. Agriculture waste i.e. sugarcane waste samples were collected from farmland in Kasaba bawada, Kolhapur. All the collection and analysis is done in the time period of year 2021 to 2022.

Methodology

The Study includes analyzing physico-chemical characteristics of food waste, municipal solid waste and agriculture waste as pH, EC, Moisture, Organic Carbon, Organic Matter, Nitrogen, Phosphorous and Potassium. These parameters were analyzed by standard protocols (APHA, 1999; Maithi, 2002).

Results and Discussion

Food Waste: Characters were recorded of food waste from the canteen of Shivaji University. The pH was in the range of 3.9 to 6.3 (Table 1). This pH decreased in first 10 days then it increased as degradation proceeds of sample. Microorganisms present in the waste were fermenting the nutrients generating some organic acids, such as acetic acid and butyric acid. Therefore pH value of the food waste was typically lesser than 7 (Zhao *et al*., 2017). Moisture played important role in the process of degradation, during degradation moisture was found decreased. Moisture noted as 54.50 %to 34.32%. Organic matter recorded as 20.10% to 16.15% (Table 1) it showed decrease in organic matter. Nitrogen showed reduction in nitrogen percentage takes place in degradation treatment from 0.36% to 0.12 %. The analysis data showed that during degradation process de-

Table 1. Physico-chemical characters of food solid waste.

Sample	pH	Moisture (%)	Organic carbon (%)	Organic matter (%)	Nitrogen (%)	Phosphorus (%)	Potassium (%)
Initial	6.3	54.50	11.65	20.10	0.36	0.04636	0.046
10Days	3.9	50.34	11.51	19.85	0.31	0.03355	0.040
20 Days	4.1	50.22	10.87	18.75	0.30	0.03210	0.037
30 Days	4.2	46.67	10.15	17.50	0.27	0.02450	0.035
40 Days	4.4	42.34	9.97	17.20	0.24	0.02140	0.027
50 Days	5.4	34.32	9.36	16.15	0.12	0.01230	0.021

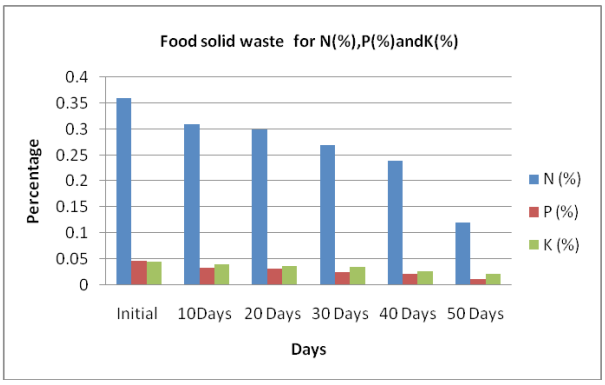

Fig. 1. Food solid waste for N (%), P (%) and K (%)

creased phosphorus was decreased from 0.046 to 0.01 %. From the result it was also evident concluded that the percentage of potassium decreased from 0.046 to 0.021%.

Characters were recorded for sugarcane farm waste at Kasaba Bawada, Kolhapur. The pH was in the range of 5.6 to 8.7. (Table 2). The pH shows decrease with advancement in the period of degradation process of sample in all the treatment of aerobic degradation. Moisture showed the range from 45.31% to 90.85% (Table 2). Moisture influences the process and amount of soluble material that are available under the somatic pressure. Under aerobic method oxygen can be consumed faster than the anaerobic method. This can retard the rate of degradation and cause changes in the microbial activity. Organic carbon content in agriculture waste showed reduction, it is noted from as 9.01% to 8.61% (Table 2). The reduction in organic carbon values was possibly due to the rapid respiration rate that leads to the loss organic carbon in terms of CO_2 or was probably due to the fact that the organic carbon was utilized by the microbes and resulted in reduction in values (Indumati, 2017). Reduction in nitrogen percentage from 0.3% to 0.12% takes place in degradation. This waste contains bacteria and fungal species which lead to greater consumption of the nitrogen. The amount of nitrogen in the compost decrease with the succession of the process (Kakade, 2015). In the decomposition of agriculture waste the nitrogen content were decreased from 1.2% to 0.85%. The analysis data showed that irrespective of treatment of degradation there was gradual increase in phosphoruscontent as the process goes on progressively. There is observed that there is increase in phosphorous percentage in all treatment from i.e.0.0049 to 0.012%. It was observed that the percentage of potassium increased as decomposition process progresses, i.e. 0.05% to 0.12 %.

The quantity and sources of municipal solid waste generated per day in the Kolhapur city 150-160 MT. It showed pH range of 5.7 to 6.9 which is

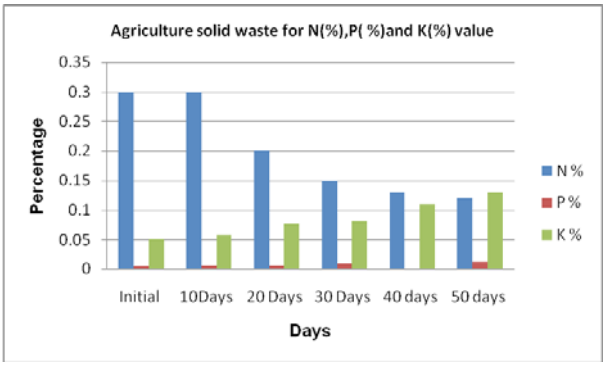

Fig. 2. Agriculture solid waste for N(%), P(%)and K(%)

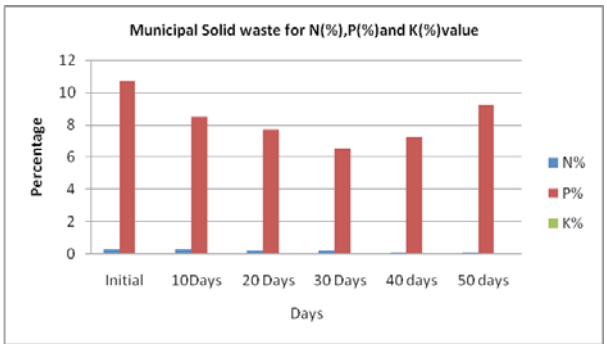

Fig. 3. Municipal solid waste for N (%), P (%) and K (%)

Table 2. Physico-chemical characters of agriculture solid waste

Sample	pH	Moisture (%)	Organic carbon(%)	Carbon matter (%)	Nitrogen (%)	Phosphorous (%)	Potassium %
Initial	8.7	90.85	9.01	15.55	0.30	0.0049	0.050
10Days	5.1	60.40	8.90	15.34	0.30	0.0063	0.057
20 Days	5.3	74.84	8.74	15.08	0.20	0.0064	0.076
30 Days	5.4	74.92	8.69	14.99	0.15	0.0090	0.080
40 Days	5.7	50.23	8.63	14.89	0.13	0.0100	0.110
50 days	5.6	45.31	8.61	14.86	0.12	0.0120	0.130

Table 3. Physicochemical characters of municipal solid waste

Sample	pH	Moisture (%)	Organic Carbon (%)	Organic matter (%)	Nitrogen (%)	Phosphorous (%)	Potassium (%)
Initial	6.9	38.88	5.90	10.179	0.03	10.7	0.006
10Days	6.3	37.88	6.39	11.020	0.03	8.52	0.005
20 Days	5.9	35.54	6.68	11.520	0.02	7.69	0.005
30 Days	5.7	32.56	6.55	11.300	0.02	6.54	0.004
40 days	6.3	34.87	3.26	5.6300	0.01	7.23	0.004
50 days	6.8	34.35	1.41	2.4360	0.01	9.25	0.003

slightly acidic. This pH range is also helpful in decomposition of solid waste. For the decomposition of solid waste pH required is in range from 5.5 to 8 (EPA, 1993). Moisture of municipal solid waste showed from 32.56 % to 38.88 %. Moisture plays important role in the process of degradation. The moisture content has its effect on micro organism's activity. Therefore proper moisture should be maintained during process of degradation according to season. Organic carbon in municipal waste noted as 5.90% to 1.42%. MSW disposal requires an adequate environmental control from waste collection to disposal and then regular monitoring of landfills (Biraje *et al.*, 2010). Nitrogen content of municipal solid waste was decreased from 0.03% to 0.01% Nitrogen is used by microorganism.Total phosphorous of municipal solid waste is in the range of 6.21% to 10.6%. It shows variation during process of degradation due to activity of microorganism. Total potassium was decreased during the process of degradation from 0.006 % to 0.003%. Microbial activity plays important role in degradation process and process dependent changes are observed in the degradation process.

Conclusion

Degradation is a non polluting method of disposal and conversion of organic waste, pH; temperature and moisture play an important role in degradation. The laboratory scale study shows that solid waste such as food waste, agriculture waste and degradable organic part of municipal waste variation shows in organic carbon, organic matter, nitrogen, phosphorous And potassium quantity. It is the easiest methods to convert the waste into into a by-product which can be utilized as an eco which can be utilized as an eco friendly soil fertilizer. Naturally degradation is preferred for the economic benefit and used efficiently.

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Conflict of interest: We declare that there is no conflict of interest.

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