# A Review on Organic Waste Management Through Composting.

**Kinjal Machhar[1], Dr. Prashakha Shukla*[2]**

1: PG student M.Sc (Microbiology), Department of Microbiology, Parul Institute of Applied Science, Parul University, Po-Limda 391760, Ta-Waghodia, Dis-Vadodara

*2: Assistant Professor, Department of Microbiology, Parul Institute of Applied Science, Parul University, Po-Limda 391760, Ta-Waghodia, Dis-Vadodara
Email - prashakha.shukla18543@paruluniversity.ac.in

**Correspondence to Author:**
**Dr. Prashakha J. Shukla**
Assistant Professor,
Department of Microbiology,
Parul Institute of Applied Science,
Parul University, Vadodara-39176
**E-mail:** prashakhashukla@gmail.com

## ABSTRACT

Food and organic waste account for up to 80% of municipal waste. These wastes lead to cause health issues if left for natural degradation for many years or properly not handled as consideration of enzymatic secretion of microorganisms. Ecofriendly management of this waste and the application of microorganisms is the greatest challenge to the Environment. Organic waste is consumed by the bacteria and is no longer to odors, pollution and sludge. The waste is converted into safe products when bacteria consume waste and produce several metabolites to break down complex waste into a simple compound. This study aimed to the management of organic waste (Food waste) through composting. The decaying of food waste Produces a large number of toxins and foul odors such as $NH_3$ and $H_2S$. Ammonia has a strong odor and can cause serious burns to the skin, eyes, and respiratory tract. $H_2S$ causes serious water and air pollution. Composting has been used to improve soil structure and fertility by recycling organic matter into the soil. In recent years, the composting process has received much attention because of pollution concerns and the search for environmental- friendly methods for treating waste.



## KEYWORDS:

Solid waste, Waste management, Food waste, Composting, Organic fertilizer, Protect Environment.

## 1. INTRODUCTION

In most developing countries improper handling of Municipal solid waste with its result becomes trouble [1]. Worldwide municipal waste generation is now about 1.3 billion tons per annum and is estimated to reach 3 billion tons by 2025 [2]. Private management systems are the most significant contributors to food waste [3]. As time is going production of food waste is increasing. The bulk of food waste carries for disposal at landfill sites, leading to environmental pollution [4]. Food waste can be used as soil fertilizers [5]. In all kitchens, there is Food waste that must be recycled waste that can be hazardous, which must be stored in a certain way [6]. Organisms that are produced from food waste are used to enhance degradation [7]. The handling of organic waste is required to reduce environmental load, and decrease hazardous to human health [9]. Most of the food waste has high moisture content due to this, it is difficult to process food waste by incineration [10]. Food waste includes fruits, vegetables, peeling, cores, and cooked or uncooked food. 95% biodegradable fragment of food waste is appropriate for anaerobic digestion [8]. Food waste is nutrient-rich, containing a high level of protein, carbohydrates, lipids, and proteins which help for getting a huge population of microorganisms [11]. Food waste contains moisture which is beneficial for good microbial growth. This microbial growth metabolizes waste into simpler compounds which is important for soil fertility and to balance the natural ecosystem [12]. In the Decomposition process Fungi and Bacteria play important role in optimal Agricultural and kitchen waste bioconversion. [13]. Food waste degradation increased by some affecting procedures. Due to having high moisture content, food waste is capable of anaerobic digestion with biogas production [14].

Composting transforms raw organic residues into humus-like material through the activity of soil microorganisms [17]. This humus-like material is called as compost which is used as organic fertilizer. Chemical fertilizers make plant nutrients more accessible to plants, but their drawbacks exceed their benefits [18]. For example, chemical fertilizers contribute to climate change, pollution, the loss of soil organisms and marine life, ozone layer depletion, and Human disease [15]. Organic fertilizers improve the soil structure, allowing it to hold water longer and increase the bacterial and fungal activity in the soil. They help not only plants but also the soil [16].

### A. Organic waste:

Organic wastes are biodegradable materials derived from living organisms such as plants, animals, and microorganisms that can be broken down into simpler organic molecules [19]. Organic wastes can be solid or liquid depending on how they are produced in nature. Agriculture, household activities, and industrial products are the three most common sources of organic waste [20]. Some of the common types of organic waste usually found in nature include:

### i. Municipal solid waste:

Municipal solid waste comprises products packaging, grass clipping, furniture, clothing, bottles, food scraps, appliances, paint, and other trash generated in our daily lives. These wastes are generated from schools, hospitals, residential areas, and businesses [21].

### ii. Cattle wastes:

Cattle wastes are animal wastes that are rich in organic substances. Cattle waste is also a valuable soil fertilizer since it has a high concentration of micro and macronutrients that are essential for crop growth and soil fertility. Organic wastes in the form of cattle wastes include manure and feed from cattle [23].

### iii. Food waste:

Food waste accounts for around 30% of all organic waste produced in nature, both naturally and artificially. Peelings, cores, leaves, fruits, twigs, outer skin, and sludges are examples of food waste [22]. Food waste is produced mostly by canning, freezing, and vegetables, as well as in residential areas, hotels, and restaurants [24].

## b. Organic waste management:

Organic waste recycling is the process of organic waste management where organic wastes are converted into useable substances using various recycling techniques [25]. As waste management has become a growing issue in most metropolitan cities, the demand for organic waste recycling has increased. Organic waste accounts for the majority of waste produced in nature, and its high moisture content has a direct impact on urban living systems [26]. Excess moisture content increases waste volume while lowering incinerator temperatures, resulting in a higher overall waste disposal load [28]. Biological treatments are one of the most practical and efficient ways to deal with organic waste [28].

### i. Composting:

Composting is a managed process that decomposes organic matter using microorganisms found naturally in organic material. It is an aerobic process that occurs under ideal moisture and biological heat generation conditions. Even though all organic matter can be composted, some materials such as woodchips and paper, take significantly longer than food and agricultural wastes to decompose [29, 27]. Some amount of wood chips is essential to increase aeration in the composting process. The composting process is driven by microorganisms, thus maintaining an ideal environment for microbial activity is essential for successful and efficient composting [31]. Composting process depends upon several parameters including carbon to nitrogen ratio (C: N),

oxygen level, temperature, the population of microorganisms, pH, time, moisture, and surface area [30].

The composting process begins as soon as the organic residues are compiled. During the active phase of composting, the temperature of the pile rises to 130-150$^0$f and may remain elevated for several weeks. It's especially vital to maintain proper aeration during this phase of high microbial activity because aerobic decomposition is the most efficient and produces finished in the shortest amount of time [32,33]. When organic matter is consumed and decomposition slows, the temperature of the compost pile drops to 100$^0$f and the curing phase begins. At the end finished compost looks dark, crumbly, and smells earthy [34].

Table (1): Suitable material for composting

| Compost | Don't compost |
|---|---|
| Yard trimming, grass clipping | Dairy products |
| Tissues, paper towels | Meat products |
| Leaves, shredded newspaper | Oils and greasy food |
| Vegetable and fruit peels | Onion and garlic scraps |
| Tea leaves, used tea | plastic |
| Brown paper product | Charcoal Ash, diseased plants |
| Sawdust, Toothpicks, wood chips | Leather goods, Diapers, black walnut |

## ii. Composting methods:

Different methods of composting are Windrow composting, Vermicomposting, Aerated static pile composting and In-vessel composting [35]. Windrow composting is one of the commonly used methods because it can treat a high volume of organic waste. This form of composting involves piling organic waste into long, narrow, heaps known as "windrow", which have a triangular or circular cross-sectional area [37]. The piles are then either manually or mechanically turned. This windrow composting method is ideal for restaurants, cafeterias, and marketplaces that create an enormous amount of food waste since the pile is large enough to generate and sustain sufficient heat [38]. However, this method is time-consuming and requires a large area of land to accommodate the large equipment [36].

Fig (1): Windrow composting [40]


Through the activity of earthworms, the vermicomposting method produces compost. The earthworms break down organic waste into higher quality compost which is known as castings [39]. Because the castings are high in nutrients including nitrogen, phosphate, and potassium, they are utilized as potting soil. The vermicomposting is inexpensive, easy, environment-friendly, and has excellent properties [41].

The Aerated static pile composting method uses either positive or negative ambient air. Along with organic wastes and bulking agents, the air is circulated through the compost pile [43]. Layers of bulking agents are added to the pile to improve airflow and add porosity to the pile [42]. Aerated static pile composting can produce compost in three to six months and is suitable for a large amount of organic waste. This method does not require as much area of land as compared to the windrow composting method [44].

In-vessel composting can process large amounts of waste without taking up as much space as windrow composting, and it can handle almost any type of organic waste [45]. Organic materials are fed into a drum, silo, concrete-lined trench, or other similar device using this method [46]. This allows good control of environmental factors such as moisture, temperature, and aeration [47]. To ensure that the material is aerated, the material is turned mechanically. The size and capacity of the vessel can differ. Compost produced in just a few weeks through this method [48].

Table (2): Benefits and Drawbacks of compost

| Benefits | Drawbacks |
|---|---|
| Enriches soil | Not suitable for all kinds of organic waste |
| Suppress plant disease and pests | Composting takes time |
| Helping retain moisture | Unpleasant smell |
| Reduce the need for chemical fertilizer | Require initial investment |

| | |
|---|---|
| Add nutrients to the soil | Needs some space |
| Reduce landfill waste | Affected by weather (outdoor compost) |
| Good for the environment | Slow-release of fertilizer nutrients |
| Fully organic fertilizer | May attracts rats, and bugs. |

Fig (2): Raw organic matter

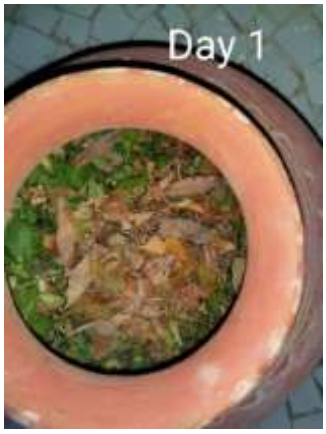


Fig (3): Finished compost

## 2. CONCLUSION:

Organic waste management using composting methods avoids odor problems, as well as gas (methane, $CO_2$) emissions and leachate in landfills and incinerators. Organic matter is converted into compost, which is used as organic fertilizer for gardening and agriculture and avoids the use of chemical fertilizer. Soil quality like fertility, water retention, porosity, and nutrient retention is improved by utilizing compost. The protection of the environment and the population's health is one of the most significant benefits of waste management.

**Acknowledgment**
It's our privilege and honor to express our sincerest gratitude to the Parul University, Vadodara, Gujarat for providing me with all the necessary support and facilities including state-of-the-art infrastructure facilities with advanced technological scientific laboratories and everything else that was required to carry out this.

### Conflicts of interest

The authors declare no conflicts of interest.

## 3. REFERENCES:


1) *M. Aatamila, et al., "Odour Annoyance near waste treatment center: A population-based study in Finland," Journal of Air and Waste Management Association, Vol. 60, No.4, 2010, pp,412-418.*
2) *Yoshizawa S, Tanka M, Shekdar AV. Global trends in waste generation. In: Gaballah I, Misha B, Solozabal R, Tanaka M, editors. Recycling, waste treatment, and clean technology. Spain: TMS Mineral, Metals and Materials Publishers; 2004. P. 1541-52 (II).*
3) *Minghua, Z., Xiumin, F., Rovetta, A., Quichang, H Vicentini, F., Bingkai. L., Giusti, Ayi, L., 2009. Municipal solid waste management in Pudong New Area, China. Journal of Waste Management 29, 1227-1233.*
4) *M. Mourad Recycling, recovering and preventing "food waste": Competing solution for food system sustainability in the United States and France J. Clean. Prod., 126 (2016), pp. 461-477.*
5) *A A Kadir et al 2016 IOP Conf. Ser.: Mater. Sci. Env Materials Science and Engineering 136 (2016) 012057, Doi: 10. 1088/1757-899X/136/1/012057.*
6) *Inglezakis V.J., Moustakas K. Household hazardous waste management: A review. J. Environ. Manage 2015; 150:310-321. DOI: 10.1016/j.jenvman.2014.11.021.*
7) *PIKE, E.B. 1975. Aerobic bacteria, in; Ecological Aspects of used Water treatment, curd, C.R. and Hawkes, H.A. (ED.), vol.1, Academic Press, London, pp 1-63.*
8) *Wang, X.M., Wang, Q.H., Ren, N.Q. and Wang, X.Q. "Lactic Acid production from Kitchen waste with a newly characterized strain of Lactobacillus Plantarum.". Chemical and biochemical Engineering Quarterly, 2005., 19(4); 383-389.*
9) *A. Khalid, M. Arshad, M. Anjum, T. Mahmood, and L.A. Dawson, "The anaerobic digestion of solid organic waste," Waste Management, vol. 31, no. 8, pp. 1737-1744,2011.*
10) *W. Kuo, and K. Cheng, "Use of respirometer in the evaluation of process and toxicity of thermophilic anaerobic digestion for treating Kitchen waste," Bioresource Technology, vol. 98, no. 9, pp.1805-1811, Jul. 2007.*
11) *Miguel Carmona-Cabello, Isabel L. Garcia, David Leiva-Candia, M. Pilar Dorado Valorization of food waste based on its composition through the concept of biorefinery Current Opinion in Green and Sustainable Chemistry, Volume 14, 2018, pp.67-79.*
12) *N. H. Heo, S.C. Park, and H. Kang, "Effects of mixture ratio and hydraulic retention time on single-stage anaerobic co-digestion of food waste and waste activated sludge," J. Environmental Science and Health, vol. 39, 7, pp. 1739-1756 Aug 2004.*
13) *Das N and Chandan P. Microbial Degradation of Petroleum Hydrocarbon contaminants: An overview SAGE Hindawi Access to Research Biotechnology. Research International. Volume 2011.*

14) *Hilkiah Igoni, M.F.N. Abowei, M.J. Ayotamuno and C.L. Eze (2008), Effect of Total Solids Concentration of Municipal Solid waste on the Biogas Produced in Anaerobic Continuous Digester.*

15) *J.B. Bien, G. Malina, J.D. Bien, and L. Wolny, "Enhancing anaerobic Fermentation of sewage sludge for increasing biogas generation," J. Environmental Science and Health, vol. 39, no. 4, pp.939-949, Feb.2004.*

16) *J.K. Cruikshank, A.H. Gawler, and C. Shaldon, "Oerskovia species: Rare opportunistic pathogens (Plate XLI)," J. Medical Microbiology, vol.12, no. 4, pp. 513-515, Nov. 1979.*

17) *R.M. Maier, I.L. Pepper, and C.P. Garba, Microorganisms and organic pollutants Environmental Microbiology. San Diego.; Academic Press, pp. 387-420, 2000.*

18) *P. Sarkar, M. Meghvanshi, and R. Singh, "Microbial consortium: A new Approach to ineffective degradation of organic kitchen waste," J. Environmental Science, vol. 2, no. 3, pp. 171-174.*

19) *J. Ma, T.H. Doung, M. Smits, W. Verstraete, and Carballo, "Enhanced bio methanation of Kitchen waste by different pre-treatments," Bioresource Technology, vol. 102, no.2, pp.592-599, Jan. 2011.*

20) *R. Usha, T. Sangeetha, and M. Palaniswany, "Screening of Polyethylene Degrading Microorganisms from Garbage Soil," Libyan Agriculture Research Center J. International, vol. 2, no. 4, pp. 200-204, 2011.*

21) *C. Behera, S. Parida, S. K. Dutta, and H. N. Thatoi, "Isolation and identification of cellulose-degrading bacteria from mangrove soil of Mahanadi-river," American J. Microbiology Research, vol. 2, no.1, pp.41-46, Feb. 2014.*

22) *P. D. Cotter, and C. Hill, "Surviving the acid test: responses of gram-positive bacteria to low pH," Microbiology and Molecular Biology Reviews, vol. 67, no. 3, pp. 429–453, Sep. 2003.*

23) *J. Ma, T.H. Doung, M. Smits, W. Verstraete, and M. Carballo, "Enhanced bio methanation of kitchen waste by different pre-treatments," Bioresource Technology, vol. 102, no. 2, pp. 592-599, Jan. 2011.*

24) *M. F. Carvalho, C. T. Alves, M. I. M-Ferreira, P. DeMarco, and P. M. L. Castro, "Isolation and Initial Characterization of a Bacterial Consortium Able to Mineralize Fluorobenzene," Applied and Environmental Microbiology, vol. 68, no.1, pp. 102-105, Jan. 2002.*

25) *Ellen MacArthur Foundation (2019) cities and circular Economy for Food. International Nut and Dried Fruit Council (2017) Food loss and Waste in the Food supply chain.*

26) *Environment Bureau (2014) A Food Waste and Yard waste plan for Hong Kong 2014-2022.*

27) *World Biogas Association and C40 (2018) Global Food Waste Management: An implementation guide for cities.*

28) *ISWA (2013) Food Waste as a Global Issue.*

29) *Ricci-Jurgensen, M. (2019) Sao Paulo's Strategy for Organic Waste Management.*

30) *Keener, Harold. (2011). Challenges and opportunities in composting organic waste. 10. 1007/978-90-481-95169_18.*

31) *Andler, S.M., Goddard, J.MM Transforming food waste: how immobilized enzymes can valorize waste stream into revenue streams. npj Scifood2, 19 (2018).*

32) *"The science of composting" composting for the Homeowner. University of Illinois. Archived from the original on 17 February 2016.*

33) *Reducing the impact of wasted food by feeding the soil and composting. Sustainable Management of food. US EPA.12 August 2015. Archived from the original on 15 April 2019. Retrieved 13 July 2021.*

34) *Khater, E. Some physical and chemical properties of compost. Int. j. Waste Resource. 2015,5,1-5.*

35) *Hemenway, Toby (2009). Gaia's Garden: A guide to Home-scale permaculture. Chelsea Green publishing. Pp. 84-85.*

36) *"Composting Large Animal Carcasses". Texas Animal Manure Management Issues. 20 July 2017.*

37) *Itavaara et al. Compost maturity-problems associated with testing. In proceeding of composting. Innsbruck Austria 18-21.10.2000.*

38) *Armugam, K.; Seenivansagan, R.; Kasimani, R.; Sharma, N.; Babalola, O. Enhancing the post-consumer waste management through vermicomposting along with bio-inoculum. Int. Eng. Technol. 2017, 44, 178-192.*

39) *Misra, R.; Roy, R.; Hiraoka, H. On farm composting methods; UN-FAO: Rome, Italy,2003; pp. 2-26.*

40) *RASHMI PATEL QUANTIFICATION OF POTENTIAL BIOGAS YEILD FROM ENEGY CROPS AND AERABLE BY PRODUCTS SCHOOL OF APPLIED SCIENCES WATER AND WASTEWATER ENGINERRINGS MSc-Scientific figure on Research gate [Accepted 5 apr,2022].*

41) *Eplde, L.; Juregi, L.; Urra, J.; Ibarretxe, L.; Romo, J.; Goikoetxea, I.; Garbisu, C. Characterization of composted organic amendments for Agricultural use. Front. Sustain. Food sys. 2018, 2,44.*

42) *Mohmmed, A.; Elias, E. Domestic solid waste management and its environmental impacts in Addis Ababa city. J. Environ. Waste management. 2017, 4, 194-203.*

43) *Alam, P.; Ahmade, K. Impact of solid waste on Health and the Environment. Int. J. Sustain. Dev. Green Econ. 2013, 2, 165-168.*

44) *Sundberg, C.; Navia, R. Is there still a role for composting? Waste manage. Res. 2014, 32, 459-460.*

45) *Pampuro, N.; Bertora, C.; Sacco, D.; Dinuccio, E.; Gringani, C.; Balsari, P.; Cavallo, E.; Bernal, M.P. Fertilizer value and greenhouse gas emission from solid fraction pig slurry compost pellets. J. Agric. Sci. 2017, 155, 1646-1658.*

46) *Khater, E.; Some physical and chemical properties of compost. Int. J. Waste Resource. 2015,5,1-5.*

47) *Epstein, E.; Willson, G.B.;Burge, W.D.;Mullen, D.C.;Enkiri, N.K. A forced aeration system for composting wastewater sludge. J. Water Pollute. Control; fed. 1976, 48, 688-694.*

48) *Fowles, T.M.; Nansen, C. Insect-based Bioconversion: Value from food waste. In food waste management; Springer, Palgrave Macmillan: Cham, Switzerland, 2022; pp. 321-346.*