Journal of Pharmacognosy and Phytochemistry
Available online at www.phytojournal.com

E-ISSN: 2278-4136
P-ISSN: 2349-8234
JPP 2018; 7(5): 2943-2947
Received: 04-07-2018
Accepted: 06-08-2018

Shweta Chaudhary
Research Scholar, Department of Human Development and Family Studies School for Home Sciences Babasaheb Bhimrao Ambedkar University (A Central University) Vidya Vihar, Raebareli Road Lucknow, Uttar Pradesh, India

Sunita Mishra
Dean, Department of Human Development and Family Studies School for Home Sciences Babasaheb Bhimrao Ambedkar University (A Central University) Vidya Vihar, Raebareli Road Lucknow, Uttar Pradesh, India

Correspondence
Shweta Chaudhary
Research Scholar
Department of Human Development and Family Studies School for Home Sciences Babasaheb Bhimrao Ambedkar University (A Central University) Vidya Vihar, Raebareli Road Lucknow, Uttar Pradesh, India

Assessment on variations in physico-chemical characteristics at different maturity phages of organic kitchen waste composting at Lucknow City U.P. (India)

Shweta Chaudhary and Sunita Mishra

Abstract
The present reserch papers deals with the evaluation of the changes happening at various stage in the decomposition of Organic kitchen waste, via the estimation of some important physico-chemical and heavy metals concentrations. Changes inside the composition characteristics of the compost over-time, included elevated electric conductivity, bulk density, water retaining capability and so forth, all through the decomposition system, wherein because the moisture content material were given reduced closer to the give up of composting. From the physico-chemical point of view, evaluation of compost's moisture content material, pH, organic matter, calcium, magnesium, total phosphorus, sodium and potassium agreed with advocated requirements and higher heavy metals concentrations became detected at all the decomposition degrees of composting and were found to be inside the permissible limits of Ohai- EPA requirements. From the results, it may be concluded that, composting by using vessel method in aerobic condition ought to produce proper acceptable quality of compost, which may be used as organic manure or soil conditioner.

Keywords: Physico-chemical characteristics, Heavy metals, Organic kitchen waste, Compost, Aerobic condition.

1. Introduction
Kitchen waste is described as left-over organic rely from eating places, lodges and families. Kitchen waste paperwork a considerable a part of domestic waste. Food waste is an undesirable uncooked or cooked food discarded all through or after food coaching that is now not healthy for intake or proper. Toxic Links at New Delhi performed a survey in May 2002 and prepared a fact document on solid waste which stated that about 0.1 million ton of municipal solid waste is generated in India daily. So, annual production of solid waste reaches about 36.5 million tones [4].

Food waste is a global problem of state. It include leftover (cooked food), spoilt greens, peeling and trimming of culmination skins and so forth. Due to excessive moisture content material and natural content within the meals wastes can be utilized inside the land-filling, composting, anaerobic digestion and so on. Therefore it's important critical to enhance food waste management on the way to reduce capability human and environment risks [28].

Composting is a natural process of rotting or decomposition of natural count number by microorganisms beneath controlled situations. Composting allows lessening the quantity of waste this is being directed into landfills. This manner a discount of concentrated, poisonous leachates and methane gas this is being released into the atmosphere, which equates to a decrease in usual pollutants. Composting also cuts down on the usage of chemical fertilizers, which damages water supply.

Compost used to enhance soil bodily and organic matter, water retention capability, drainage, pH, better availability of soil micro-organism and decreasing the negative impact of chemical based totally insecticides and fertilizers within the ecosystems.

Besides population boom, two important elements will affect the earth's surroundings within the upcoming many years: financial increase particularly for international locations with a huge populace, like India and China; and greater monetary disparity between rural and urban regions, driving the agricultural population into towns. While the primary thing leads to an extra demand for sources, along with fossil fuels, metals, water and meals, the second component leads to a greater luxurious waste control burden on huge towns. Cities international extensive are already experiencing waste coping with problems and smog problems [15].

From 20 to 80% of the mass of municipal solid waste (MSW) is made from Kitchen waste. The Food Waste percentage was observed to be inversely correlated to the monetary reputation of the community, even as the mass of food waste produced per capita was without delay correlated [1] In many nations around the globe, the landfill exercise isn't always even possible, ensuing in land and water dumping [20].

Because of its biodegradability, Food Waste attracts sickness vectors which include parasites, pathogens, bugs and vermin [20] and its right disposal can enhance the surroundings and reduce health risks.

Composting is a biochemical method wherein natural materials are biologically degraded ensuing inside the manufacturing of organic or inorganic via merchandise and electricity inside the form of warmth [10]. Heat is trapped inside the composting mass, main to the phenomenon of self-heating this is traits of the composting manner [25].

Composting is a microbiological process, little is understood about microorganisms involved and their activities during unique stages of the composting method. Defining the variety and structure of microbial communities of compost via their constituent populations has been of tremendous interest to compost researchers so as to deal with primary ecological questions along with how comparable are microbial communities in mature compost that have been performed from extraordinary feedstocks and the use of one-of-a-kind composting strategies [29]. Composting is a spontaneous organic decomposition technique of organic materials in a predominantly aerobic environment.

A sustainable technique requires containment, accumulation, delivery, processing, and disposal of Municipal Solid Waste (kitchen waste) with an objective to load reduction on landfills along with fabric healing/recycling [30, 27]. There are numerous techniques in use worldwide for waste processing into value-added products within the form of compost (natural fertilizer), biogas, animals feed and chemical compounds [3]. Composting is an ecofriendly biochemical technique and a viable alternative for a sustainable MSW control [11].

1.1 Study location

Lucknow is the capital and largest town of the Indian nation of Uttar Pradesh and is also the executive headquarters of the eponymous District and Division. It is the 11th maximum populous metropolis and the twelfth most populous urban agglomeration of India. The city stands at an elevation of about 123 metres (404 feet) above sea level. Lucknow district covers an area of 2,528 rectangular kilometres (976 sq.Mi). According to the provisional file of 2011 Census of India, Lucknow town had a population of 2,815,601 [17, 18, 19, 32].

Due to industrialization and urbanization inside the Lucknow metropolis, populace and municipal solid waste has improved concurrently So, the study was undertaken to assess physico-chemical, traits and heavy steel concentrations at different stage in distinct maturity stages of composting procedure of Organic kitchen waste composting. This observe could help to recognize the degradation of kitchen wastes composting at diverse ranges.

The era of municipal waste, both garbage and sewage has been on the rise. Anthropogenic activities in society generate massive portions of wastes, posing a trouble for their disposal. Improper disposal ends in spreading of sicknesses and unhygienic conditions, besides spoiling the aesthetics. Therefore, waste management is crucial element of Lucknow town.

2. Materials and Method

2.1. Feedstock preparation

Kitchen waste become gathered from the main hostel mess of Baba Saheb Bhim Rao Ambedkar University Campus Lucknow, India often for one week in order to get a homogenous aggregate of feedstock. The collective meals waste changed into considered as a representative sample of the waste produced in hostel mess due to all styles of meals waste. The total wide variety of people input into mess for breakfast is round 150 according to day, whereas during the lunch time the entire variety exceeds 300 in step with day. The moisture content material (MC) of the accrued sample become 82.6%, and the use of such moisture wealthy waste aggregate in the composting manner can create waterlogged or anaerobic situations [5]. Therefore, the sample was solar-dried for 24 h to attain the preferred MC (70%) for composting process, as consistent with popular suggestions of Brinton (2000) [5] and EPA (2014).

2.2. Experimental setup

A laboratory scale in-vessel compost bioreactor made of plastic with a complete running potential of 10 kg become commissioned and used. Dimensions of the reactor have been: top 63.5, diameter 66.6 cm and thickness 10 mm. The vessel turned into blanketed with aluminum foil and styrofoam to prevent warmness losses. The reactor became filled with combined and ground feedstock as much as 70%, while 30% of the place was saved as a head area. The thermometer was fixed in the center of the compost bioreactor to display the temperature changes during the method. After loading the feedstock, the bioreactor lid became closed. Air flow changed into done through pores located at the lid of the bioreactor. Shredding of the compost combination was performed robotically through an agitator for attaining uniform mixing and oxygen (O2) supply in the course of the experiment as encouraged by way of [2]. The method of aerating the compost materials via turning and combining become followed consistent with the system defined by Singh and Kalamd had (2014), [26, 13]. The samples have been then transported in sealed aluminum foil to the laboratory, wherein stones, plastic and metals have been removed, oven dried at 700degree Celsius and the compost is homogenized via a 2 mm sieve. The compost samples were saved within the dark bottles until similarly analysis.

2.3. Analysis of compost samples

2.3.1. Physico-chemical evaluation

All experiments had been completed in triplicates. The accrued degraded compost samples had been analysed for numerous physico-chemical traits along with Moisture content material (drying at 105 0C to regular weight by gravimetric technique); Particle densities (Pycnometric method); pH (1:5 water extract by means of pH meter); Electrical conductivity (1:5 water extract, conductivity meter); Calcium and Magnesium (1N ammonium acetate, EDTA approach); Organic matter (ashing); Ammonia nitrogen (1:5 sodium acetate extract, Nesseler's reagent approach); Phosphorus (tri acid combination with a aqua digestion); potassium and sodium (1N ammonium acetate extract the use of flame photometer approach) wellknown approaches for evaluation [12, 23, 21].

2.3.2. Heavy metal analysis

The 1g of oven dried sample turned into transferred to one hundred ml beaker. A tri acid aggregate (10 ml) such as

HNO3, H2SO4 and HClO4 inside the ratio nine:2:1 became introduced to every of the flasks with a hundred ml of distilled water and digested on hot plate till the dense fumes of HClO4 stop, to get a clean extract. The beakers were then allowed to cool and the extracts had been filtered with Whatman No.42 filter out paper. The filtrates have been diluted to 100 ml in general flasks to have an adequate quantity of solution for evaluation. The dilution component turned into noted. The water soluble and acid digested extracts were analyzed for quantitative estimation of heavy metals (copper, lead and mercury) the usage of atomic absorption spectrophotometer [21].

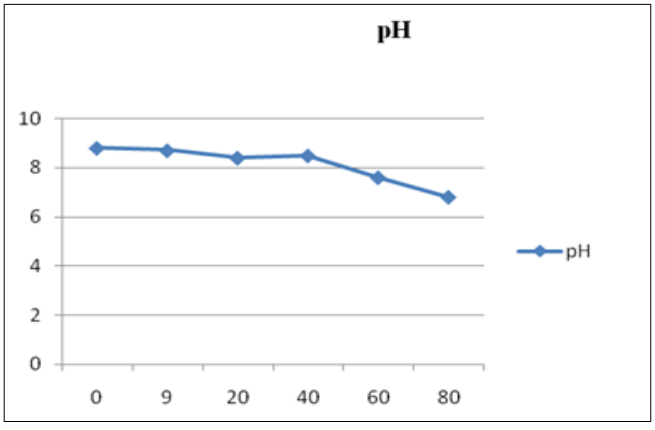
3. Result and Discussion

The physico-chemical characteristics at different stages are presented given in Table.1

Table 1: Physico-chemical characteristics of collected kitchen waste compost samples during different maturity phages of composting process (February 2017 to April 2017)

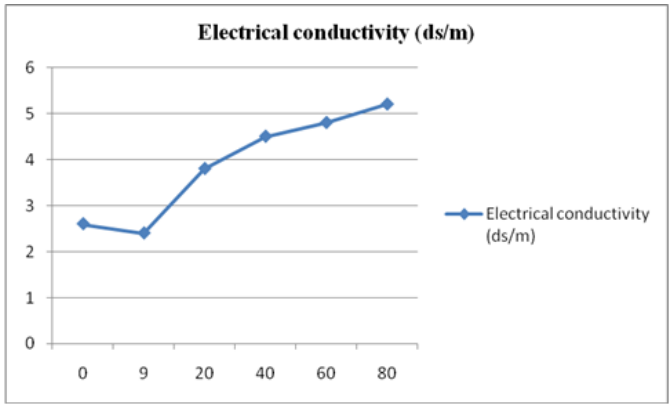
Parameters	Days				
	9	20	40	60	80
1. Moisture Content (%)	86.22	85.12	86.28	81.14	61.28
2.pH	8.7	8.4	8.49	7.6	6.8
3. Particle Density (mg/m3)	2.5	2.3	2	1.64	0.64
4. Electrical conductivity (ds/m)	2.4	3.8	4.5	4.8	5.2
5. Water holding capacity (%)	18.22	30.9	51.6	60.12	75
6. Organic matter (%)	29.32	28.35	23.82	14.6	17.36
7. Total Organic carbon (%)	16.62	15.11	13.82	12	11
8. Sodium (%)	0.036	0.02	0.040	0.06	0.08
9. Potassium (%)	0.07	0.07	0.08	0.12	0.13
10. Total phosphorus (%)	1.44	4.12	6.23	6.26	12.47
11. Calcium (%)	9.55	10.61	16.63	30.49	61.4
12. Magnesium (%)	0.87	3.11	4.78	9.03	11.52
13. Ammonia nitrogen (%)	1.68	2.63	4.2	2.26	1.61
Heavy Metals					
14.Copper (mg/kg)	242	154.1	218.1	212.1	202.1
15.Lead (mg/kg)	7	8	5	3	1
16.Mercury (mg/kg)	3	1	1	0	0

Based on above findings the result and discussion are as follows:-

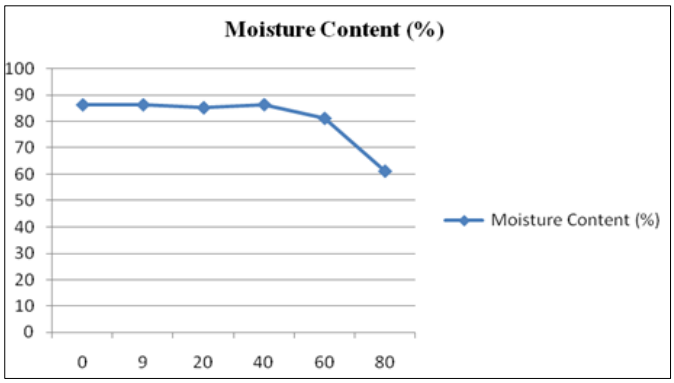


Ph value of compost discriminates its acidic or alkaline nature during composting. in our study, pH was initially very high 8.8, represents its alkaline nature in comparison with recommended value (Neutral pH 7) [4]. As days of composting progressed there was slightly decrease in pH of composting material as shown in Figure1. pH of compost was alkaline around 45 days of composting, and became almost neutral (pH=7.6) on around 60 days of composting. on 80Th day pH compost material becomes acidic. Highest pH in initial days of composting is due to may be presence of high amount of ammonia produced due to proteolitic process. Decrease in pH can be explained as the production off several organic acids results from the fermentation process of fats and carbohydrates.

Due to organic matter degradation in post composting days, pH tend to decrease, and the degraded organic matter is consumed as substrate by small microbes. Neutral pH phenomenon is found during maturation of composting material around 60 days of composting. The change in pH value during composting process is a specific indicator of decomposition and stabilization.



Salt component in composting material including, chloride, potassium, nitrate, sulphate and ammonia salts [5] carries electrical charges and maintain the ability of electrical conductivity of compost. In our composting material, initial EC was less 2.6 which increased in a consecutive manner and were highest around 60 days of composting as expected and recommended [6]. reported that degradation of organic matter tend to increase EC of compost to high values. Decrease in EC could also be explained as increase in concentration of nutrients such as nitrites and nitrates.



Total biomass of compost can be characterized between moisture content and dry mass as the percentage of initial weight. Activities of microorganism is directly propositional to the moisture content of the compost as moisture component of compost provides medium for their transport. Moisture content is concordantly varies with temperature and envoi mental conditions [7]. In this study moisture content ranges from 86.23% to 61.28%. Since from the first day moisture content was high, and it decreased during thermophilic stages to slight ranges only. The result on 50 and 60 days were concordant to the recommended ranges [16]. also found decrease in the moisture content of compost during high evaporating rates due to high temperature. Moisture content of compost between 50 to 60% represents favorable

Conditions for microorganism to grow and multiply as well as their optimal transport medium.

Increased in water holding capacity of compost indicates that compost has been utilized in growth of media.This shows that water content in the pores increases with days of composting.

At a specific time, after complete gravitational loss of water from compost, the amount of water remains in pores is termed as water holding capacity of compost. initial water holding capacity of the compost was 18% while it increased rapidly in post follow up days and reached maximum to 75% on the 80th day of composting.

Particle density varied from 2.5-0.64 mg/m3 which shows that as composting progresses the particle density decreases [4].

Organic matter is a key constituent of soil structure. It provides soil structure, nutrient availability and water holding capacity. In this study the Organic matter found between 29.32%- 17.36%. There is a some decrease in the percentage.

As the composting progresses the total organic carbon percentages decreases from 16.62 to 11 percent. This decrease in percentage indicates that the degradation of waste is by the action microbes [22].

Sodium and Potassium in composting stages varied at different stages of compost maturity. Both are highly soluble and gets easily leached. In the starting days of composting, Sodium found (0.036% -0.08%)to be high and after that it goes on decreasing and it is good because more sodium content in compost leads to damage in soil structure and increase permeability resulting in alkaline salt and which is harmful to plants.

Potassium is a important plant nutrition. It helps plant's growth and it increases as the composting progresses. It ranged between 0.07% -0.13%.

Total phosphorus ranged between 1.44% - 12.47% which shows that it increasing along with the composting maturity stages. Total phosphorous content slowly increased during composting process and water solubility of phosphorous decreased with humification, therefore phosphorous solubility during the decomposition was subjected to further immobilization factor [7]. It is also a plant growth promoting element.

Calcium and Magnesium are the main plant nutrients. In this study Calcium ranges from 9.55% - 61.4% and Magnesium ranges from 0.87% - 11.52%. Both elements found to be increasing in various degradation stages of Kitchen waste composting. Since kitchen waste is organic and biodegradable in nature it is also rich in calcium and magnesium content.

In this study, ammonia nitrogen ranged from 1.68% to 1.61 %. In comparison with recommended requirements [4] the ammonia nitrogen have been determined better in all of the pattern. Highest concentrations of NH4-N are produced in the first few weeks of composting. In fact, the ratio of organic and inorganic varieties of nitrogen has been used as a maturity index. In the final stage concentration of NO3-N is more than the concentration of NH4-N which would imply that the process happened below optimum conditions of aeration and that mature compost was produced [24].

Copper, Lead and Mercury varied in permissible amount prescribed by Ohai EPA [8] standard As kitchen waste is an organic and biodegradable in nature therefore there are no high amount of heavy metals detected. There are traces of some heavy metal found in the composting stages due to the chemical fertilizer and pesticide content in the kitchen waste material used for composting. In this study the variation of Copper, Lead and Mercury was 242-202.1mg/kg, 7-1mg/kg and 3-1mg/kg respectively.

4. Conclusion

Based on the above study it is concluded that due to urbanization of Lucknow and also being a densely populated metropolitan city it results in high rate of waste generation. And due to this Lucknow city is at great risk of environment pollution and health hazards. As this research paper focuses that composting is a sustainable approach to waste management, Kitchen waste composting by using aerobic vessel method may be considered as an eco- friendly and also job orienting method at large scale. The municipal solid waste committee also adopts this method as job and wealth creating approach. Kitchen waste composting is safe for using as natural organic manure and also as soil conditioner.

5. Acknowledgement

One of the authors Shweta Chaudhary is grateful for the financial support provided by the University Grant Commission, Ministry of Human Resource Development, Government of India, along with her Supervisor and Dean of the Department Prof. Sunita Mishra for her guidance and motivation for this research work.

References

1. Adhikari BK, Barrington S, Martinez J. Predicted growth of world food waste and methane production' Waste Management & Research. 2006; 24:421-433.
2. An CJ, Huang GH, Yao Y, Sun W, An K. Performance of in-vessel composting of food waste in the presence of coal ash and uric acid. J. Hazard. Mater. 2012; 203:38e45.
3. Awasthi MK, Pandey AK, Bundela PS, Wong JW, Li R, Zhang Z. Composting of gelatin industry sludge combined with organic fraction of municipal solid waste and poultry waste employing zeolite mixed with enriched nitrifying bacterial consortium. Bioresour. Technol. 2016; 213:181e18.
4. Bord na Mona. Compost testing and analysis Service – interpretation of results, available from Bord na Mona, Newbridge, Co. Kildare, 2003.
5. Brinton WF. Compost Quality Standards and Guidelines (Final Report by Woods End Research Laboratories for the New York State Association of Recyclers), 2000.
6. Campell AG, Folk RL, Tripepi RR. Wood ash as an amendment in municipal sludge and yard composting processes, Compost Science & Utilization. 1997; 5(1):62-73.
7. Elango D, Thinakaran N, Panneerselvam P, Sivanesan S. Thermophilic composting of municipal solid waste, Applied Energy. 2009; 86(5):663-668.
8. EPA. Composting Draft Guideline. Publication number, 2014, 1577.
9. Authorised. Published by EPA, Victoria, Victoria Street, Carlton, Australia, 2000.
10. Hogos SEG, Juarez JV, Ramonet CA, Lopeg JG, Rios AA, Uribe EG. Aerobic thermophilic composting of waste sludge from gelating-grenetine industry. Resurces Conservation and Recycling. 2002; 34:161-173.
11. Jara-Samaniego J, erez-Murcia MD, Bustamante MA, P, erez-Espinosa A, Paredes C, *et al*. Composting as sustainable strategy for municipal solid waste management in the Chimborazo Region, Ecuador: suitability of the obtained composts for seedling production. J. Clean. Prod. 2017; 141:1349e1358.
12. Jackson ML. Soil chemical analysis, Prentice Hall of India, New Delhi publication, 1973.

13. Jindo K, Sonoki T, Matsumoto K, Canellas L, Roig A, Sanchez-Monedero MA, 1973.
14. Influence of biochar addition on the humic substances of composting manures. Waste Manage. 2016, 49, 545e552.
15. Kaur, Manmeet, Arora S. Isolation and Screening of Cellulose Degrading Bacteria in Kitchen Waste and Detecting Their Degrading Potential. Journal of Mechanical and Civil Engineering. 2012; 1(2):33-35.
16. Kumar S, Gawaikar V, Gaikwad SA, Mukherjee S. 'Cost-benefit analysis of landfill system witrh gas recovery for municipal solid waste management: A case study' Intern. J. Environ. Studies. 2004; 61(6):637- 650.
17. Larney FJ, Blackshow RE. Weed seed viability in compost Beef cattle feedlot manure, Journal of Environmental Quality. 2003; 32:1105-1113.
18. Lucknow pips Kanpur, emerges as most populous city in UP". The Times of India. Lucknow. 6 April 2011. Retrieved, Lucknow gets bigger by 380 sq km in 10 yrs". The Times of India. Lucknow. 12 February 2011. Retrieved 12 January 2018.
19. Lucknow directory of service". *Lucknow Online*. Retrieved 27 August 2014.
20. Louis GE. A historical context of municipal solid waste management in United States' Waste Manage Res. 2004; 22:306-322.
21. Mani AK, Santhi R, Sellamuthu KM. A handbook of laboratory analysis, 1st edition, A.E. Publications No.10. Sundaram, P.N. Pudur, Coimbatore, ISBN 978-81-902558-8-2, 2007, 156-167.
22. Mondini C, Dell'Abate MT, Leita L, Beneditti A. An integrated chemical, thermal and microbiological approach to compost stability evaluation, Journal of Environmental Quality. 2003; 32:2379-2386.
23. Saha, Arun Kumar. Methods of Physical and Chemical Analysis of Soil, 1st Edition, pubilisher Kalyani. ISBN 8127242084, India, 2008.
24. Sanchez-Monedero MC, Mondini M, Nobili L, Leita, Roig A. Land application of biosolids. Soil response to different stabilization degree of the treated organic matter, Waste Management. 2004; 24(4):325-532.
25. Semple KT, Reid BJ, Fermor TR. Impact of composting stragies on the treatment of soils contaminated with organic pollutants. Environmental Pollution. 2001; 112:269-283.
26. Singh J, Kalamdhad AS. Influences of natural zeolite on speciation of heavy metals during rotary drum composting of green waste. Chem. Spec. Bioavailab. 2014; 26(2):65e75.
27. Shahzad K, Nizami AS, Sagir M, Rehan M, Maier S, Khan MZ *et al*. Biodiesel production potential from fat fraction of municipal waste in Makkah. PloS one. 2017; 12 (2):e0171297.
28. Chaudhary S, Mishra S. Food waste management: a global issue, International Journal of Current Research. 2017; 9(01).
29. Tiquia SM, Michel FC. Bacterial Diversity in Livestock manure compost as characterized by terminal restriction fragment length polymorphisms (T-RFLP) of PCRamplified16S rRNA gene sequences, 2002.
30. Walker L, Charles W, Cord-Ruwisch R. Comparison of static, in-vessel composting of MSW with thermophilic anaerobic digestion and combinations of the two processes. Bioresour. Technol. 2009; 100:3799e3807.
31. Waqas M, *et al*. Optimization of food waste compost with the use of biochar, Journal of Environmental Management, 2017, http://dx.doi.org/10.1016/j.jenvman.2017.06.015.
32. Welcome to Lucknow District Official Website, 2010, Lucknow.nic.in. Retrieved.