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RESEARCH ARTICLE

Physiochemical Analysis of Sandalwood (*Santalum Album*) Leaf Litters Degraded by *Eisenia foetida* and *Eudrilus eugenia*

Praveesh Bhati[1]*, Ritu Nagar[2], Anurag Titov[2]

[1] DNA Fingerprinting Unit, State Forensic Lab, Civil line Sagar (M.P.), India
[2] Govt. Madhav Science PG College, Dewas road Ujjain, (M.P.), India

* Corresponding author email: bhati_p212@yahoo.co.in

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ABSTRACT

The decay of leaf litter by microflora and fauna furnish nutrient supply to the soil and also uphold ecological sustainability. Applying of proper technique and exploring of result provides information for the betterment of agricultural system. Vermicomposting of Sandalwood (*Santalum album*) leaf litters were studied with an emphasis of physio-chemical deviation during the process and also compared with 100 % cattle dung. Obtained result explore that temperate of 50 % leaf litter (LL) and 100 % cattle dung (CD) was slightly elevated (37ºC ±1 ºC and 35ºC ±1 ºC respectively) at beginning phase and later came down to ambient level (20ºC±1 ºC). The total organic carbon (TOC) exhausted 44 % in 50 % LL Vermicomposting mixture while 70 % in 100 % CD during the process. At the final stage, TOC found more in 50% LL as compared to 100% CD. Nitrogen content was found 1.02±0.1 in 50 % LL and 0.88±0.1 in 100 % CD at the initial phase but after completion of Vermicomposting, their level was increased up to 40 to 44 %. pH was also measured during vermicomposting and found 7.2±0.1 in 50% LL while 8.4±0.1 in 100% CD at the initial phase. The at the end of process pH raised and set up to 8.2 ±0.1 in 50% LL while in 100% CD it was found 8.0 ±0.1.

Keywords: *Eisenia foetida, Eudrilus eugenia,* sandal leaf litter, Vermicomposting, waste management.

1 Introduction

Population explosion and their life expectancy have consequence in a larger production of waste worldwide [1]. Paper waste, plant waste, slaughter house waste, garden waste , vegetable & fruit waste, dairy waste, food processing waste, animal waste , house hold waste, human waste etc are different verity of waste generated in urban area. [2]. The huge amount of generate waste creates more burden on existing ecosystem as well health concern of human-being [3]. It has been estimated that there are 0.1kg to 0.5 kg municipal solid waste (MSW) generates per person per day in small city to metro city in India [4]. Leaf litter is a type of organic waste creates major problem in public place, residential society, educational campus which make compound dirty [5, 6]. Apart from that their daily collection and transportation to dump area is too costly [7]. Along with this, improper treatment of these leaf litters at dumping area also causes environmental pollution. Sometimes dry leaves are burnt which is also immoral practice for remediation of plant waste because it not only causes air pollution but also make soil deficient for essential nutrients [8,9]. It has been estimated that during burning of plant materials sulphur, carbon and nitrogen lost 75 to 100% while phosphorus and potassium lost about 20% which is commonly found in plant materials [10]. As a good and chipper source, dry leaf litter can be converted into nutrient rich compound for their reuse in agriculture field [11]. The present effort was done to sustainable utilization of Sandalwood leaf of our college

campus Govt. Madhav Science P.G. College Ujjain (M.P.), India. Sandalwood plant recognised for their unique aromatic woods which retain their fragrance for decades [12]. It has also great medicinal value. Our college densely covered with sandal wood tree. Plunging of leaf from sandal wood tree create problem for their disposal. Vermicomposting of sandalwood leaf is most alternative way to sort out such problem. It will also produce nutrient rich organic manure beneficial to campus plant. However, the studies on vermicomposting of sandalwood leaf litter and physical parameters changes during process is not work out Hence, the present study was carried out to vermicompost the sandal leaf litter in combination with cow dung.

2 Materials and Methods

2.1 Collection of Compost Materials

The dry leaf litter of Sandal wood tree was collected from our college campus Govt. Madhav Science P.G. College Ujjain (M.P.), India [13]. These wastes were shredded to small pieces and were mixed with equal amount of cattle dung in plastic bins and allowed for pre-digestion till the favourable condition regarding the earthworm not achieved. During the period distilled was sprinkled [14, 15].

2.2 Collection and Maintenance of Earthworms

The exotic earthworm variety, *E. eugenia* and *E. Foetida* selected for the current study were collected from vermiculture centre, Govt. Madhav Science P.G. College Ujjain (M.P.), India. These earthworms were allowed to adapt to the laboratory conditions for a period of 10 days before the initiation of the experiment [16].

2.3 Vermicomposting of Leaf Litters

Vermicomposting of pre-digested sandal wood leaf litter waste was done in plastic bins by windrow method. There were two setups established in triplicate manner were 50 % dry leaf waste mixed with cattle dung and 100 % cattle dung. In each bin final weight was taken up to 2.0kg. A total of 20 earthworms (10 -10 of each species) of both variety *Eisenia foetida* and *Eudrilus eugenia* were added on the surface of mixture of each bin [17]. Bins were avoided by direct expose under Sun light, adverse environment and natural enemies. During the whole period of vermicomposting, adequate moisture was maintained by addition of distilled water. Composting mixture was mixed intermittently. Process was carried out until the surface of mixture seems black granular [18].

2.4 Physio-biochemical Analysis

During the period parameters *viz.* temperature, organic carbon, total nitrogen, nitrates ($N\text{-}NO_3^-$) and pH was measured in vermicompost sample. Temperature was measured by mercury thermometer at three distinct depth of each bin [19]. To measure organic carbon, total nitrogen, nitrates ($N\text{-}NO_3^-$) and pH parameters, 10 grams of Vermicompost were collected after ten days of interval. Collected sample was allowed to dry in hot air oven at 60ºC for two hours. Vermicompost was powdered, filtered and placed into polythene bags. The organic carbon was estimated following Walkey and Black chromic acid wet oxidation method. In this method compost was mixed with two volumes of H_2SO_4 and one volume of the dichromate. The remaining dichromate was titrated with ferrous sulphate. The nitrogen content was determined by the modified Micro-Kjeldhal method. In this method compost was treated with sulfuric acid in the presence of a catalyst followed by distillation of the ammonia which trapped in solution. Formed ammonia titrated with a standard solution. $N\text{-}NO_3^-$ by Brucine and UV-visible Spectrophotometry method. In this method compost mixture mixed with 18 N sulfuric acid and allow to heat followed by addition of sodium hydroxide solution. Obtained solution mixed with buffer solution and finally make up with distilled water. The absorbance of such yellow colour solution was measured at 410 nm using reagent blank as a reference. For pH determination, sample of vermicompost material diluted with distilled water in 1:10ratio (w/v) and allow shaking at room temperature for 1 hour. After filtration, filtrate was used to determine pH [20].

3 Results and Discussion

Vermicomposting is a technique to uplift lower quality waste into high quality nutrient rich compound called vermicompost. In present study vermicompost of sandal wood leaf litter waste was obtained after 90days of process. During the process factors *viz.* temperature, pH, Total organic carbon (TOC) and total Kjeldhal nitrogen (TKN) was measured which depicted in table no.1. Temperature regime of vermicomposting bins shows that. at beginning phase temperature was high but steadily lowers down and set at constant point similar to ambient temperature.

First four weeks, the temperature was high (>30°C) in both 50 % leaf litter and 100 % cattle dung vermicompost mixture. Later, there was a slow reduction in temperature that touched at minimum level was 20°C (ambient temperature). It was also found that, higher temperature was recorded in 50 % leaf litter vermicompost than 100 % cattle dung vermicompost bins during the entire period of decomposition process. It was also explored that there were 17°C difference between initial and final temperature of 50% leaf litter vermicompost while in case of 100 % cattle dung it was about 15°C ± 1°C (Fig 1). The main cause of more temperature in 50 % leaf litters is due to availability of organic carbon in abundant quantity. Initial temperature was raised because of biochemical processes and decomposition of organic components of waste. As soon as organic waste depleted the temperature also turn down and set at lower constant value [21]

Table 1: *Physiochemical characteristics of Sandalwood leaf litter waste and cattle dung mixture*

Weeks	Temperature (°C)		Carbon (%)		Nitrogen ±0.1		pH (±0.1)	
	50% LL 50 % CD	100 % CD	50 % LL 50 % CD	100 % CD	50 % LL 50 % CD	100 % CD	50 % LL 50 % CD	100 % CD
0	30±1	30±1	45.12±0.1	34.21±0.1	1.02±0.1	0.88±0.1	7.2±0.1	8.4±0.1
1st	37.9±1	35.6±1	42.35±0.1	31.24±0.1	1.03±0.1	0.93±0.1	5.7±0.1	8.6±0.1
2nd	35.7±1	34.3±1	39.65±0.1	29.25±0.1	1.04±0.1	1.00±0.1	6.3±0.1	8.5±0.1
3rd	33.8±1	32.5±1	33.25±0.1	26.45±0.1	1.07±0.1	1.10±0.1	6.5±0.1	8.4±0.1
4th	30.7±1	30.8±1	27.14±0.1	23.68±0.1	1.13±0.1	1.16±0.1	7.4±0.1	8.4±0.1
5th	28.9±1	27.8±1	22.41±0.1	20.12±0.1	1.18±0.1	1.19±0.1	7.5±0.1	8.3±0.1
6th	26.3±1	25.4±1	19.22±0.1	18.45±0.1	1.21±0.1	1.20±0.1	7.7±0.1	8.2±0.1
7th	24.8±1	23.3±1	17.24±0.1	14.49±0.1	1.27±0.1	1.22±0.1	7.8±0.1	8.2±0.1
8th	22.9±1	21.6±1	16.02±0.1	11.21±0.1	1.32±0.1	1.23±0.1	7.9±0.1	8.1±0.1
9th	21.5±1	20.8±1	15.56±0.1	10.30±0.1	1.38±0.1	1.25±0.1	8.1±0.1	8.0±0.1
10th	20.5±1	20.3±1	15.25±0.1	10.20±0.1	1.43±0.1	1.29±0.1	8.2±0.1	8.0±0.1

(**Note:** LL= leaf litter, CD = cattle dung)

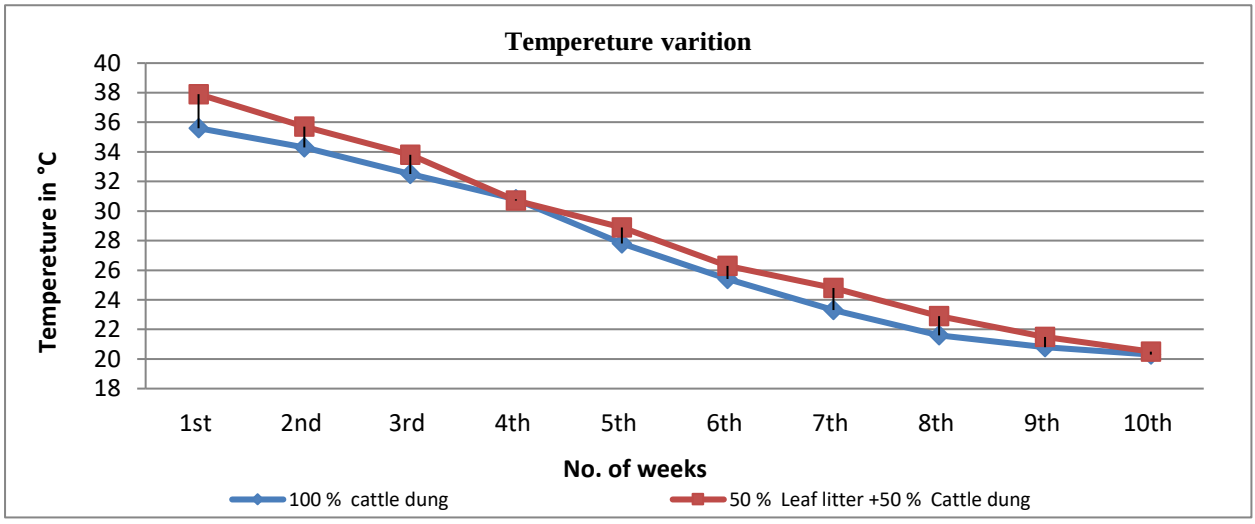

Figure 1: *Temperature variation in Sandalwood leaf litter waste and cattle dung mixture*

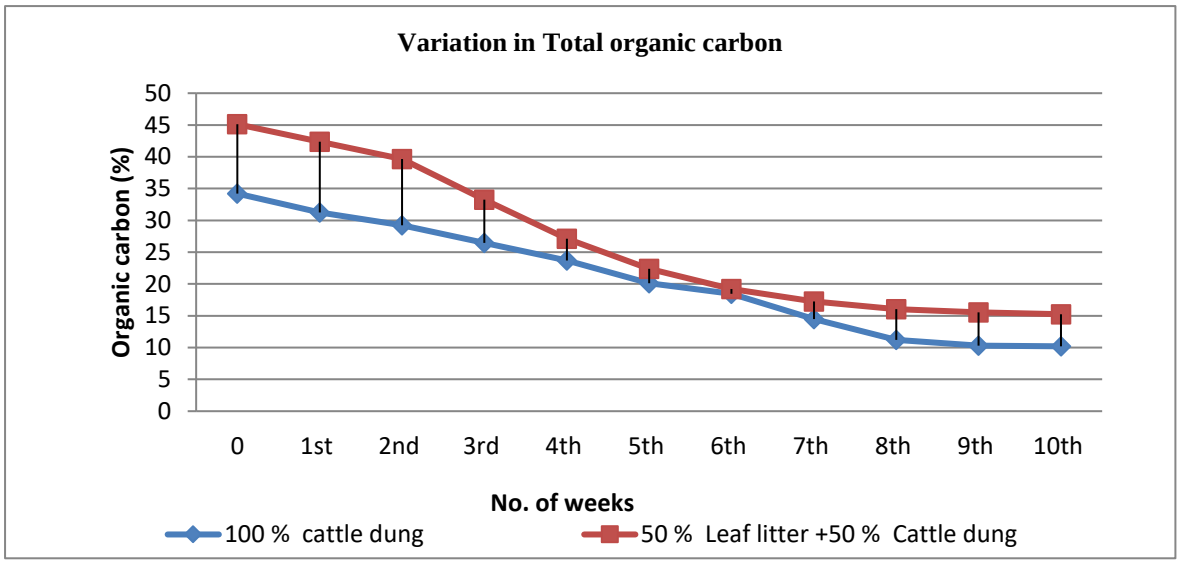

Figure 2: *TOC depletion in Sandalwood leaf litter waste and cattle dung*

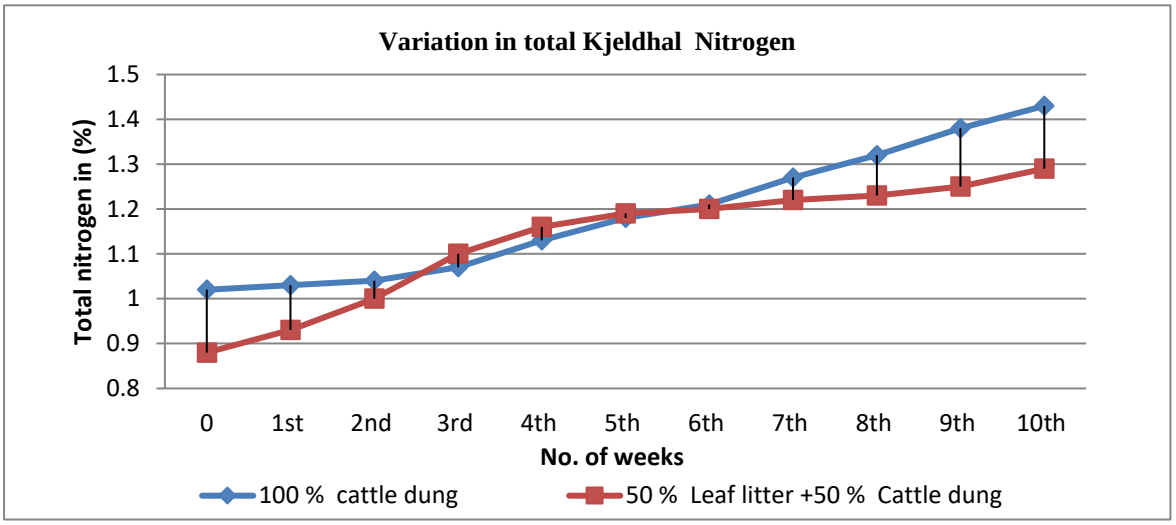

Figure 3: *Total Kjeldhal Nitrogen variation in Sandalwood leaf litter waste and cattle dung*

Total organic carbon was also measured during process of vermicomposting. Obtained data revealed that 50 % leaf litter contained more TOC (45.12 % & 15.25) as compared to 100 % cattle dung (34.21 % & 10.20 %) at beginning phase as well as at end phase. Result also explore that during vermicomposting 29 % depletion took place in 50 % leaf litter waste while 14 % depletion took place in 100 % cattle dung (Fig 2). It has to be supposed because cattle dung obtained after absorption of digested food in the alimentary canal of cattle. Therefore, it contains less concentration of total organic compound. In case of 50 % Vermicomposting mixture, contains raw material in excessive quantity therefore it has more total carbon then 100% cattle dung. In case of 50 % Vermicomposting waste, because simplest form of biological compound such as carbohydrates, oligo-peptides, fatty acid are found which exhausted rapidly in the primary phase of Vermicomposting therefore more reduction take place in total carbon of this mixture but letter this depletion slow down because of complex organic substance such as cellulose, hemicelluloses and lignin found remain at the end of process. It has also found that organic compound mineralizes gradually throughout the stage of composting [22].

The deviations in total Kjeldhal nitrogen during the Vermicomposting process are shown Fig. 3. There was increase in total N contents in both 50 % leaf litter and 100 % cattle dung. The total N content in 50 % leaf litter vermicompost waste mixture was 1.02 % and 0.88 % was in 100 % cattle dung at first week. After 10th week it was reached at 1.43 % and 1.29 % respectively. The

N enrichment process during Vermicomposting depends upon the microbial populations and proportion of organic wastes which contains organic compound. Microorganisms fix atmospheric nitrogen into assimilatory form which also increases the level of nitrogen. During Vermicomposting, nitrogen also added by worms in the form of mucus and nitrogenous excretory material [22-24].

During Vermicomposting process, pH was also measured which is shown in Fig. 4. The initial pH values were 7.1and 8.3 of 50 % leaf litter and 100 % cattle dung respectively. In case of 50 % leaf litter the first week of Vermicomposting, pH was decline and reach up to 5.6 while in cattle dung it was increased up to 8.3. After first week, pH of 50% leaf litter was increased and finally set around 8.0. The initial drop in pH was also observed by several researchers in their experiment [13, 25, 26]. pH drop in early phase of 50 % leaf litter might be due to presence of simple organic carbon compound which utilized by microorganism and release organic acid [14, 27]. Once carbohydrate source depleted, alternate energy source *i. e.* Nitrogenous organic compound utilized by microbial community which leads to generate ammonia as a result pH turn increase [28].

4 Conclusion

Vermicomposting is a promising approach to turn waste into best. This technique based upon efforts of microorganisms which influenced by environmental as well as physiochemical factors. Present study revealed that physical and chemical parameters of Vermicomposting alter at a significant level. Temperature and pH of composting materials greatly affect when cattle dung mixed in equal ratio. It has been also found that level of total organic carbon and nitrogen significantly higher in 50% leaf litter waste as compair to 100 % cattle dung. Obtained result suggested that leaf litter may be a good source for preparation of vermicompost in term of essential nutrients viz. carbon and nitrogen as compaired to cattle dung alone. Changes in physical factors also recommend that at which time of Vermicomposting process earthworm should be added.

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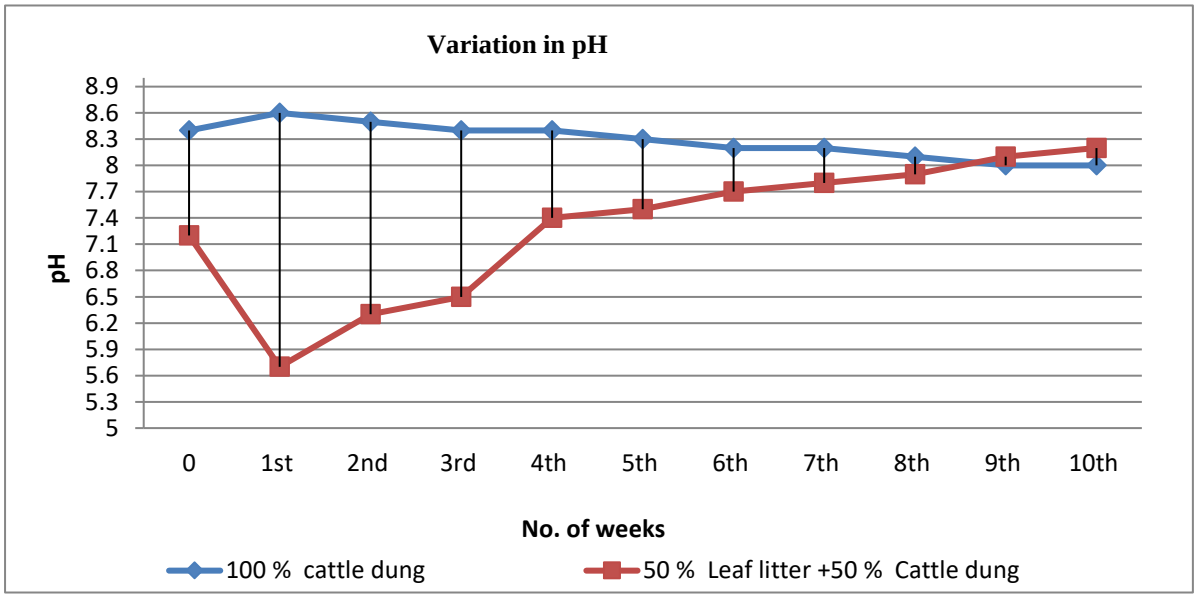
We are thankful to Principal, Govt. Madhav Science College for providing permission for conducting vermicomposting of leaf waste. The authors also wish to express their warm gratitude to the Department of Botany, Biotechnology & Microbiology for accompanying laboratory experiment.

Figure 4: *pH variation in Sandalwood leaf litter waste and cattle dung.*



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References

[1] T. M. Palanivel and H. Sulaiman, "Generation and Composition of Municipal Solid Waste (MSW) in Muscat, Sultanate of Oman" *APCBEE Procedia* ,vol.10,pp.96 – 102, 2014.

[2] S, Shouche, P. Bhati & S. Jain, "Recycling wastes into valuable organic fertilizer: vermicomposting", *International Journal of Researches in Biosciences. Agriculture & Technology*,vol.2,no.2,pp.520-527,2014.

[3] Y. Zhao, T.H. Christensen, W. Lu, H. Wu and H. Wang, "Environmental impact assessment of solid waste management in Beijing City, China", *Waste management*, 31: pp.793-799, 2011.

[4] M. Rawat, A. Ramanathan and T. Kuriakose, "Characterisation of Municipal Solid Waste Compost (MSWC) from Selected Indian Cities—A Case Study for Its Sustainable Utilisation," *Journal of Environmental Protection*, Vol. 4 No. 2, 2013. pp. 163-171.

[5] Kalanatarifard and G.S. Yang, " Identification of the Municipal Solid Waste Characteristics and Potential of Plastic Recovery at Bakri Landfill, Muar, Malaysia", *Journal of Sustainable Development* , vol.5,no.7, p11,2012.

[6] S.N .Thitame, G.M. Pondhe, D.C. Meshran, "Characterization and Composition of Municipal Solid Waste (MSW) generated in Sangamner city, District Ahmed nagar, Maharashtra, India", *Environment Monitoring Assessment*, vol.170, pp.1-5, 2010.

[7] Boldrin, and T. H. Christensen, "Seasonal generation and composition of garden waste in Aarhus (Denmark). *Waste Management*, vol., no. 4, pp.51-557, 2010.

[8] D.R. Chaudhary, S.C. Bhandari and L.M. Shukla, "Role of vermicompost in sustainable Agriculture –A Review", *J. Agri. Rev*, vol.25,no. 1,pp.29-39,2004.

[9] A.K. Sannigrah, "Biodegradation of leaf litter of tree species in presence of cow dung and earthworms" *Indian Journal of Biotechnology*.vol.8, pp. 335-338, 2009.

[10] P.K. Sharma and B. Mishra, "Effect of burning rice and wheat crop residues in loss of N,P,K and S from soil and changes in the nutrients availability", *J. Indian Soc Soil Sci*, vol.49,pp.425-429,2001.

[11] R. Nagar, A. Titov and P. Bhati, "Vermicomposting of Leaf litters: Way to convert waste in to Best", INT J CURR SCI, vol.20, no.4, pp. E 17-25, 2017.

[12] R. Nagar, A. Titov and P. Bhati, "Transformation of sandalwood leaves (*Santalum album*) into nutrient rich compound through vermicomposting", *IJHAF*, vol.2,no.3, 39-45,2018.

[13] R. Nagar, A. Titov, and P. Bhati, "Study of Changes in Physical Parameters of compost and vermicompost of Eucalyptus leaf litters", *Adv. J. Grad. Res.*, vol. 4, no. 1, pp. 34-40, Apr. 2018.

[14] S. Shouche, P. Bhati and P. Pandey , "Study about the changes in physical parameters during vermicomposting of floral wastes", *Journal of Environmental Research and Development*, vol.6,no.1 ,pp.63-68,2011.

[15] R. Nagar, A. Titov, and P. Bhati, Prolific Utilization of Earthworm Species to Convert Green Leaf of Jamun (Black Plum) Into Soil Nutrient. Academy of Agriculture Journal, Vol.3, Issue.2, 2018, Page No: 240-245, 2018.

[16] R. Nagar, A. Titov, and P. Bhati, Vermicomposting of green Eucalyptus leaf litter by *Eisenia foetida* and *Eudrilus eugenia*. *International Journal of Environment, Agriculture and Biotechnology.* 2(6):2811-2818, 2017.

[17] S. Shouche, P. Bhati**,** and S.K. Jain, "Recycling wastes into valuable organic fertilizer: Vermicomposting", *International Journal of Researches in Bioscience, Agriculture and Technology*, vol.2, no.2 ,pp.520-527, 2014.

[18] L. Shinde, N. B. Gokhale, N. H. Khobragade, M.C. Kasture, V.N. Palsande, S. S. Pawar, P.V. Patil, and N.S. Joshi, "Vermicomposting: recycling organic wastes into valuable eco-friendly fertilizer", *Plant archives*,vol.15,no.1,pp.315-317,2015.

[19] L. B. Taiwo and B. A. Oso, "Influence of composting techniques on microbial succession, temperature and pH in a composting municipal solid waste", *African. Journal of Biotechnology*, vol.3, no.4, pp.239-243, 2004.

[20] American Public Health Association. *Standard methods for the examination of water and wastewater*. Method 4500-NO3- Part E. 4500-NH3 E. 18th Edition. Washington, D. C.(1992).

[21] X. Lefebvre, S.Lanini and D. Houi "The role of aerobic activity on refuse temperature rise :I. Land fill experimental study," *Waste Manage .Res*,vol.18, no.5,pp. 444–452, 2000.

[22] M.P. Bernal, J.A. Alburquerque and R. Moral, "Composting of animal manures and chemical criteria for compost maturity assessment. A review", *BioresourTechnol*,vol.100,pp.5444–5453,2009.

[23] R.M. Atiyeh, N.Q. Arancon, C.A. Edwards and J.D. Metzger , "Influence of earthworm-processed pig manure on the growth and yield of greenhouse tomatoes", *Biores. Technol*, vol.75,pp.175–180.2000.

[24] S. Suthar, "Potential utilization of guar gum industrial waste in vermicompost production". *Bioresour. Technol*, vol.97,pp.2474–2477,2006.

[25] P.R. White, M. Franke and P. Hindle, "Integrated solid waste management: a lifecycle inventory", Chapman and hall, London,(1995).

[26] C. Elvira, L. Sampedro, E. Benitz, I. Walter and R. Calbo, "Vermicomposting of sludge from paper mill and dairy industries with *Eisenia andrei*: A pilot scale study" *Bio resource Technology*, vol.63,pp. 205-211,1998.

[27] P.M. Ndegwa and S.A. Thompson, "Effects of C to- N ratio on vermicomposting in the treatment and bioconversion of biosolids", *Bioresource technology*, vol.76,pp. 107-112,2000.

[28] V.L. Mckinley and R.J. Vestal, "Physical and chemical correlates of microbial activity and biomass in composting municipal sewage sludge", *Appl Environ Microbiol*, vol.50 1395–1403, 1985.