Bulgarian Chemical Communications, Volume 47, Special Issue D (pp. 163 – 166) 2015

Studying changes amount of useful chemical elements for pistachio trees in vermicompost animal manure than initial animal manure

Saman Haj Mohammadi[1], Sohrab Haj Mohammadi[2]

[1]*Department of Chemistry, Sirjan Branch, Islamic Azad University, Sirjan, Iran*
[2]*Young Researchers and Elites Club, Sirjan Branch, Islamic Azad University, Sirjan, Iran*

Received June 26, 2015; Revised September 10, 2015

Today, vermicompost process with earthworms has been focused to stabilize waste materials. Consistent and rapid steady passing of materials from congestive system of eart hworm along crushing, grinding, stirring, and mixing it in various parts of this path and staining these materials with all types of congestive system secretions of this animal, and finally providing proper conditions to synthesize humic acid lead to produce a totally different material in properties from sank materials that is called vermicompost. Since there are contradicted records about vermicompost nutritious materials (K, P, N, Fe, Ca, Mg, B, S, Cu, Zn, Mo Mn), the first matter arising for a former is about amount of nutritious materials in vermicomposts and also organic materials and proportion of carbon to nitrogen in obtained vermicomposts from animal manures (sheep, cow, chicken, and fish) and whether it has significant changes from initial animal manures or not. According to affluent benefits of vermicomposts, the necessity of developing its producing system and supporting its producers is one of important today global needs with significant help to reduce costs and keeping environment that humans are dependent on it for living. This study explores nutritious materials needed for pistachio trees in vermicomposts manure. Obtained vermicomposts is a proper organic modifier to improve agricultural soils fertilization for pistachio trees.

Keywords: animal manure, decomposition process, pistachio tree, quality control

INTRODUCTION

Farmers spend too high costs for animal manures annually. This manures are used for soil fertilization and fertility of pistachio trees. Costs of buying and transferring these manures are problems for farmers. Therefore, composting chemical manures has been focused recently. Composting is a proper method, because it is affordable economically. Composting by organic materials by microbial, thermal, and aerobic methods is done by a great population of natural microorganisms leading to stability, handling, removing undesirable odors, and producing high humic materials. Compost is easy to store and supply for selling [13]. Many researchers have emphasized on efficiency of using earthworms in changing chemical manures to usable vermicompost manures in agricultural lands [2]. Adding earthworms to process of vermicompost is a proper technology to manage chemical manures. Earthworms' activities protect aerobic condition and increase speed of microbial decomposition. Weights of alive earthworms increase and their rich nutritious wastes are produced in this process [12]. Adding plumping materials to animal manures increases worm activities and improve production quality [14]., 1999). Gondek&Filipek-Mazur [3] used conifer sawdust, cardboard trinkets, and straw trinkets as plumping by proportion of 15% mixture to prepare vermicompost manure. Arumuga et al. [15] used mixture of sludge, rice straw, and animal manure to prepare vermicompost in 2004. Vigueros& Ramirez-Camperos [10] used water hyacinth as plumping material. These researchers also saw significant reduction in population of coliform bacteria and parasite eggs. Eastman et al. [9] showed that population of fecal coliform bacteria and parasite eggs in vermicomposts were very lower than compost and producing vermicompost is a very proper substitute method for compost class A. Studies have been so limited in Iran particularly no study was about using native worms and effect of various plumping materials and their mixture proportion to sludge and worms reproductions. Naddafi et al. [16] (2004) used *Eisenia foetida* species in experimental level to produce vermicomposts from sewage sludge of Tehran. In Shahmansuri et al. [17] (2005) experiment, aggregation of heavy elements in native and importing earthworms, *Eisenia foetida* species, was explored in production process of vermicompost. The purpose of this study is exploring feasibility of

To whom all correspondence should be sent:
E-mail: samalbert_908@yahoo.com

changing animal manure to organic manure using native vermicomposts and changing useful chemical elements to feed pistachio trees in these manures. In addition, the best and most proper plumping material were examined for these manures.

METHODS AND MATERIALS

This study was done in a workshop near Sirjan city. Experiment was in framework of split factorial that steps of changing animal manure was considered as the main factor and type of plumping materials and mixture percentage were considered as factorial. Samples of animal manures were bought in bulk and initial experiments were performed to determine the present elements in these manures. Samples of manure types were dried and ground under 50 °C during 48 hr. 1 gr of this material was burnt in electric furnace and extracted by HCL 2N acid. The obtained extraction was used to determine all chemical elements (Jones et al, 1999). Chemical properties of manures in various decomposition steps were measured including PH, EC in extraction 1:5 (distilled water and materials), organic carbon by Walkley Black method, total nitrogen by Kjeldahl automatic system made by Gerhard Co. model 2020, total phosphorus by colorimetric method, total sodium and potash by flame photometer method, calcium and magnesium by complexometry, and Iron, copper, and zinc by spectrophotometry (Sparks, 1996). The most proper changing step, type of plumping materials, and proportion of mixing manures with plumping materials was determined using one-way variance analysis tests and Duncan compare means test by Spss and MSTATE software. Differences in mixture of manure with plumping was considered by proportion of 0%, 15%, 30%, and 45% and worm number in 1*1 environment was considered as 300 worms.

Table 1. Chemical properties of animal manures in initial decomposition step.

Properties	Sampling step			
	Sheep manure	Cow manure	Chicken manure	Fish manure
PH	8.00	7.5	7.5	7.2
Electric conduction (dS/m)	25.33	19.74	46.00	41.02
Organic carbon (%)	77.30	85	73.63	80.25
Total nitrogen (%)	3.22	2.71	4.08	3.55
C/N proportion	6.36	6.45	3.34	4.87
Phosphorus (%)	0.78	0.59	1.98	1.59
Potash (%)	2.98	2.24	1.76	3.35
Calcium (%)	1.80	1.42	7.11	4.45
Magnesium (%)	0.47	0.45	0.89	0.77
Sodium (%)	0.21	0.15	0.35	0.32
Iron (mg/kg)	4368.5	1856.13	1681.22	2023.10
Zinc (mg/kg)	148	209.8	462	380.70
Copper (mg/kg)	26.97	54.77	123.5	134.40
Magnesium (mg/kg)	352.78	238	528.39	446.23

Table 2. Chemical properties of plumping materials used in the test.

Properties	Plumping materials	
	Leaf of pistachio tree	Wood chip of pistachio tree
Organic carbon (%)	18.8	22.5
Total nitrogen (%)	1.12	0.092
C/N proportion	16.8	244.6
Phosphorus (%)	0.199	0.018
Potash (%)	0.21	0.11
Calcium (%)	3.2	4.8
Magnesium (%)	2.4	3.7
Sodium (%)	0.62	0.45
Iron (mg/kg)	23	19
Zinc (mg/kg)	0.2	0.5
Copper (mg/kg)	1.2	0.7
Magnesium (mg/kg)	3.45	3.6

Table 3. Comparison interactive effects of factors on worms' weights

Material	Mixture percentage	Worm weight
leaf	0 %	11.23 c
Leaf	15 (%)	19.23 bc
Leaf	30 (%)	14.99 c
Leaf	45(%)	13.04 c
Wood chip	0 (%)	12.99 c
Wood chip	15 (%)	21.17 b
Wood chip	30 (%)	32.79 a
Wood chip	45 (%)	24.35 b

Table 4. Chemical properties of animal manures in final step of analysis

	Sampling step			
Properties	Sheep manure	Cow manure	Chicken manure	Fish manure
PH	7.5	7.00	7.1	7.5
Electric conduction (dS/m)	28.23	23.13	49.13	45.60
Organic carbon (%)	81.45	91.50	79.12	89.33
Total nitrogen (%)	2.90	2.13	3.38	2.88
Phosphorus (%)	1.09	0.63	2.32	1.67
Potash (%)	3.34	2.54	1.97	3.67
Calcium (%)	1.85	1.45	7.12	4.40
Magnesium (%)	0.50	0.45	0.91	0.80
Sodium (%)	0.32	0.27	0.46	0.44
Iron (mg/kg)	4634.43	1987.87	1875.09	2365.37
Zinc (mg/kg)	156	231	495	410
Copper (mg/kg)	33.29	61.80	139.20	145.78
Magnesium (mg/kg)	355	241	530	448

RESULTS

Chemical properties of manures are shown in Table 1:

As it is seen, these manures have neutral PH and relatively proper EC for plants growth particularly pistachio tree. C/N for all 4 manures is proper (for cow manure is more than others) and this issue reduces necessity of using plumping materials to compensate carbon. Analysis of plumping materials (leaf and chips of pistachio trees) is collected in Table 2:

In this research, leaf of pistachio tree is used as plumping material for having proper C/N.

Leaf of pistachio tree was fully dried and mixed to 15% of animal manure and explored to 300 worms during 2 months. Results of table 4 shows analysis of composed animal manure by worms:

CONCLUSION AND DISCUSSION

Vermicompost is biologic organic manure obtaining by consistent steady passing of organic materials while decomposition in digestive system of earthworms species and removal of these materials from worms body. By passing these materials from worm body, they are stained to digestive system (Mucus), vitamins, and enzymes which are finally produced and used as a rich organic and very useful manure for construction and soil nutritious elements improvement. To be assure of quality and security of organic manure, some parameters are controlled during composing process. These parameters are examined based on physical, chemical, and microbial analyses from the first to the end of process based on standards.

By comparison results of table 1 and 4, we can see that PH and EC didn't change so much. Organic carbon increased as interaction of animal manures with secretion materials of worms' digestive systems and nitrogen reduced for removal of some nitrogen compounds in worms as N_2 gas from the obtained compost. Other elements such as phosphorus, iron, zinc, and potash changed significantly which are really effective in growth of pistachio tree. According to increase in useful elements of vermicompost than initial manure, it is useful for pistachio trees, but usage amount should be mentioned, because some elements are not only harmful for pistachio trees, but also cause irreversible damages in their products.

REFERENCES

1. A.R. Parvaresh, H. Movahhedian, L. Hamidian, *Water & Waste Water*, **15**, 29 (2004).
2. C. Elvira, L. Sampedro, J. Dominguez, S. Mato, *Soil Biol. Biochem.*, **29**, 759 (1997).
3. K. Gondek, B. Filipek-Mazur, *Electronic Journal of Polish Agricultural Universities, Environmental Development*, **4** (2) (2001).
4. G. D. Harris, W.L. Platt, B.C. Price, *Biocycle*, **31**, 48 (1990).
5. J. B. Jones, B. Wolf, H.A. Mills, Plant analysis handbook: A practical sampling, preparation, analysis and interpretation guide. Macro-Micro Pub. Inc., Athens, GA, 1991, p. 23.
6. M. S. Maboeta, L. van Rensburg, *Water, Air Soil Poll.*, **150**, 219 (2003).
7. T. Manios, E.I. Stenifored, *J. Environ. Sci. Health*, **41**, 1235 (2006).
8. D.L. Sparks, Methods of Soil Analysis, Part 3, Chemical Methods. SSSA Book Series Number 5, Soil Science Society of America, Madison, WI, 1996.
9. B.R. Eastman, P.N. Kane, C.A. Edwards, L. Trytek, B. Gunadi, A.L. Stermer, J.R. Mobley, *Compost Sci.& Utilization*, **9**, 38 (2001).
10. C. Vigueros, E. Ramirez-Camperos, *Water Sci. Technol.*, **46**, 153 (2002).
11. http://www.ejpau.media.pl/series/volume4/issue2/environment/art-01.html.
12. E. Benitez, R. Nogales, C. Elvira, G. Masciandaro, B. Ceccanti, *Bioresource Technol.*, **67**, 297 (1999
13. A. Quatmane, M. R. Provenzano, M. Hafidi, N. Senesi, *Compost Sci.&Utilization*, **8**, 124 (2000).
14. J. Dominguez, C. A. Edwards, M. Webster, *Pedobiologia*, **43**, 372 (1999).
15. G.K. Arumuga, S. Ganesan, R. Kandasamy, R. Balasubramani D.R. Burusa, 2004. Municipal Solid Waste Management through Anaecic Earthworm, *Lampito Mauritti* and their Role in Microbial Modification. Eco Service International, Available at: http://www.eco-web.com/editorial/040831.html
16. K. Naddafi, M. Zamanzadeh, A.A. Azimi, G.A. Omrani, A.R. Mesdaghinia, E. Mobedi, *Pakistan J. Biol. Sci*., **7,** 1217 (2004).
17. M.R. Shahmansouri, H. Pourmoghadas, A.R. Parvaresh, H. Alidadi, *Iranian J. Env. Health Sci. Eng.*, **2**, 28 (2005).