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An Assessment on Microbial Quality of Produced Vermicomposts in Yazd City in 2015

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ABSTRACT

Introduction: Organic fertilizers are beneficial to maintain and improve structure of the soil nutrients; however, in case of presence of pathogenic microbial agents and pathogens inside them, it will result in health problems and disease transmission. Therefore, present study aimed to determine microbial quality of produced vermicomposts in Yazd city.

Materials and Methods: This study was a descriptive-analytical work where 10 % of vermicomposts production centers which were using cow manure were randomly selected in Yazd city and sampling was conducted in spring. In doing so, the desired microbial indices were measured and ultimately compared to the standard A of Iranian compost. Three samples were prepared from each center and in each sampling; 50 g of sample was picked. Finally, total number of taken samples was 30. The tests included determination of the probable number of fecal coliform bacteria and parasite eggs.

Results: According to the results of present study, the mean fecal coliform and parasite eggs for all centers were 1272 in confidence interval of 95 % (441-2102) and 0.73 in confidence interval of 95 % (0.32-1.13), respectively. Therefore, the mean fecal coliform and parasite eggs in derived vermicomposts were in class A standards range of Iranian compost.

Conclusion: Production of vermicomposts by animal fertilizers in Yazd city not only decreases these wastes but also gives rise to manufacture a strategic and valuable product which is in range of determined standards and is suitable for soil improvement and fertility.

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Introduction

Desirable management of urban and industrial wastes according to high volume of their daily production is of a great importance particularly in terms of environment and health. Given the limited suitable places for disposal of the wastes as well as unsuitable effects of wastes' disposal and additional methods of wastes removal or control on public health and environment, the movement towards optimal management of wastes is one of the main goals in the developed and developing countries with a glance on suitable development [1]. A major part of urban wastes compounds in Iran is composed of corruptible organic materials. If such organic materials be separated from wastes compounds and be biodegraded under special conditions, the final product will be manufactured as compost fertilizer, mixed fertilizer, compound fertilizer or humus. In other words, the process of conversion of solid wastes into fertilizer is known as compost process [2]. Vermicomposts production is a semi-aerobic process (a moisture content of 80 %) which is carried out by a special species of worms, fungi, bacteria, and actinomycetes. Also, vermicomposts

are combination of the materials resulted from the worm growth bed left in the environment upon waste disposal through the worm's digestive system. Therefore, this material is a set of worm castings along with decomposed organic materials and worms' bodies which are of high nutritional value for plants [3]. Since organic fertilizer is often derived from urban solid wastes and there is always the possibility of pollution and diverse pathogens in compost materials and also because there may be a defect in accurate process of temperature generation and increase, it is necessary to pay attention to health control and assurance of the derived compost in terms of public health. Several reports have shown changing procedure of pathogens in vermicomposts process. The first report on pathogens changing procedure in vermicomposts process was presented by the United States Environmental Protection Agency (USEPA) [4]. In the study conducted by FarzadKia et al., on microbial quality of the compost fertilizer produced in compost factories of Tehran and Khomein, the results indicated that the products of the two factories are in Class B of compost. Also, in another study carried out by Amouei et al., entitled as "an assessment on quality of the compost produced from rural wastes in Babol city", the results showed that the produced fertilizer is included in the Class A of American Compost [5]. Xuelian Liu et al. reported a decrease in *Escherichia coli* O157:H7 bacteria at vermicomposts process of artificial soil [6]. Manuel Aira et al. reported a considerable decrease of pathogens in vermicomposts process of cow manure [7]. Furthermore, in another study conducted by Karimi et al., on the vermicomposts derived from mixture of cow manure, sludge from wastewater treatment, and food wastes, authors reported that fecal coliforms and parasite eggs considerably decreased [8]. Also, María Gómez-Brandón carried out a study on microbial and chemical properties change of the fertilizer produced in compost and vermicomposts process and showed significant decrease of microbial factors after 60 days [9]. Organic fertilizers are beneficial for maintenance and improvement of the soil nutrients structure but in case of pathogenic microbial factors and pathogens inside them, they may result in health problems and disease transmission. For this reason, before use of vermicomposts in the soil, assessing the number of pathogenic factors is necessary. Therefore, the present study aimed to determine microbial quality of vermicomposts produced in Yazd to make producers, consumers, and corresponding organizations informed.

Materials and Methods

The current descriptive-analytical study was conducted in Yazd in spring of 2015. Among an approximate number of 100 vermicomposts production centers available in Yazd, 10 centers using cow manure were randomly selected. The sampling was carried out in spring and the desired microbial indices were measured. The introduction of Iranian General Standard was applied and the derived results were compared to the class A of composts standard. Three samples were provided from each center and in each sampling, 50 g of the sample was picked. Ultimately, a total number of 30 sample pieces were taken. The tests associated with microbial quality were conducted for the final product. These tests included determination of probable number of fecal coliforms and parasite eggs for which the specific culture medium A1 and Zinc Sulfate were used, respectively. After preparation of the desired culture mediums, 5 g of the sample was inseminated in a non-selective liquid enrichment culture medium of peptone water. After insertion in incubator shakers for 5 minutes in a temperature of 25℃, samples were inserted into an incubator with a temperature of 37℃ for 16-20 hours. Identification of coliforms using 9-tube fermentation method was carried out in A1 medium and in this test; three dilutions including 1, 0.1, and 0.01 were used under Bain-marie serological conditions with the temperature of 41.5℃ for 20-24 hours 10.

For conducting parasites identification tests, half of a test tube was filled with zinc sulfate solution. Then, after transmission of 1g of the sample into the tube, the suspension was prepared. The mentioned suspension was passed through a double-layer gauze and the filtered solution was then returned into the

tube. Zinc sulfate solution was added into the tube to reach the solution surface up to 2-3 mm of the tube opening. After centrifuge operation with a speed of 3000 rpm for a minute, a loop was picked from supernatant solution of the tube and added to the lamella containing Lugol in order to conduct identification operation under microscope 11. All the above tests were carried out in Chemistry and Microbiology Laboratory of Faculty of Health of Shahid Sadoughi University of Medical Sciences, Yazd, Iran. After accomplishment of tests on the samples and specifying rate of each parameter, the quality of final fertilizer was compared to the corresponding standards and quality of the derived compost was determined. Statistical analysis of this study was carried out through ANOVA and T-TEST statistical tests by SPSS software package.

Ethical issues

This study was conducted with the approval of Shahid Sadoughi University of Medical Sciences and Health Services, Medical Ethics Committee. Code: IR.SSU.SPH.REC.1394.34

Results

Microbial analysis results on vermicomposts produced in Yazd are presented in table 1.

In this Table, the mean fecal coliform can be seen at each center. In addition, the lowest and the highest fecal coliforms are stated along with the standard deviation, as well (Table 1).

Table 1: Characterized fecal coliform in all centers

	N	Mean	Minimum	Maximum
Center 1	3	1610.00	630.00	2100.00
Center 2	3	173.33	140.00	230.00
Center 3	3	3946.66	210.00	11000.00
Center 4	3	226.66	200.00	240.00
Center 5	3	2933.33	2100.00	4600.00
Center 6	3	40.00	40.00	40.00
Center 7	3	120.00	40.00	230.00
Center 8	3	1676.66	70.00	4600.00
Center 9	3	866.66	70.00	2100.00
Center 10	3	1126.66	530.00	2100.00
Total	30	1272.00	40.00	11000.00

Given the above chart, the mean fecal coliform has the highest and lowest values in the centers 3 and 6, respectively (Figure 1).

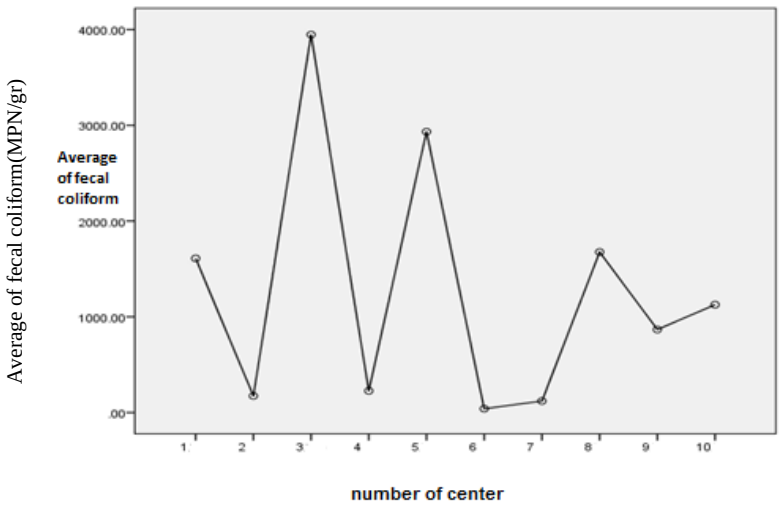

Figure 1: Frequency distribution of fecal coliform variable

According to the results of variance analysis test (ANOVA) and using above Table, no significant difference was seen among 10 centers in terms of mean fecal coliform at the alpha level of lower than 5% and significance level of variance analysis (0.427) (Table 2).

One-sample t-test was used to state significance or insignificance of standard mean difference and fecal coliform in produced vermicomposts in Yazd.

Table 2: Significant expression of lack of significant difference between the mean values of fecal coliform in the ten center of analysis of variance (ANOVA) was used

Analysis of variance test						
		Sum of squares	**Degrees of freedom**	**Mean of squares**	**F**	**Significance level**
Fecal coliform	Between group	46566013.33	9	5174001.48	1.07	**0.43**
	Intergroup	96997666.67	20	4849883.33		
	Total	143563680.00	29			

As per above table, no significant difference was seen between mean fecal coliforms in the vermicomposts produced in Yazd and specified standards while mean fecal coliform is lower than standard (Table 3 - 4).

Table 3: Specification descriptions related to fecal coliform

One-sample t-test statistical significance				
	Frequency	**Mean**	**standard deviation of**	**The average standard deviation of error**
Fecal coliform	30	1272.00	2224.97	406.22

Table 4: One-sample t-test

One-sample t-test				
	The base value = 1000			
	T	**Degrees of freedom**	**Significance level**	**Mean difference**
Fecal coliform	0.670	29	0.508	272.00000

In below table, mean parasite egg are mentioned for each center. The lowest and the highest parasite eggs in each center are stated along with the standard deviation, as well (Table 5).

Table 5: Specifications descriptive Parasite eggs

		N	**Mean**	**Minimum**	**Maximum**
Parasite eggs	Center 1	3	2.00	0.00	3.00
	Center 2	3	1.00	0.00	3.00
	Center 3	3	0.00	0.00	0.00
	Center 4	3	0.66	0.00	1.00
	Center 5	3	1.00	0.00	3.00
	Center 6	3	0.33	0.00	1.00
	Center 7	3	1.33	0.00	2.00
	Center 8	3	0.33	0.00	1.00
	Center 9	3	0.66	0.00	1.00
	Center 10	3	0.00	0.00	0.00
	Total	30	0.73	0.00	3.00

In accordance with above chart, the mean parasite eggs have the highest and lowest values in the centers 1 and 10, respectively (Figure 2).

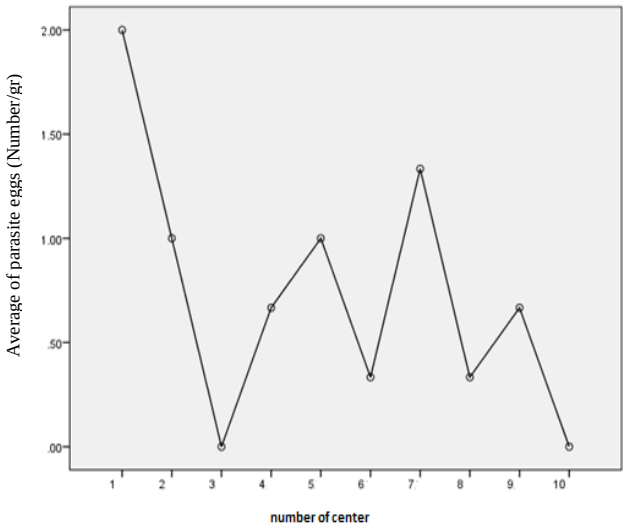

Figure 2: Frequency distribution of parasite eggs variable

The results of above table show no significant difference between mean parasite eggs in the produced vermicomposts in Yazd and the standards while mean parasite eggs is lower than standard (Table 6 - 7).

Table 6: Specifications descriptions related to parasite eggs

One-sample t-test statistical significance				
	Frequency	**Mean**	**standard deviation of**	**The average standard deviation of error**
Parasite eggs	30	0.73	1.08	0.19

Table 7: One-sample t-test

One-sample t-test						
	The base value = 1					
	T	**Degrees of freedom**	**Significance level**	**Mean difference**	**Confidence Interval 95%**	
					Lower Bound	**Upper Bound**
Parasite eggs	0.67	29	0.51	272.00	-558.82	1102.82

Discussion

Pathogens removal from the vermicomposts produced from diverse wastes can be used for soil improvement and is of high importance to prevent transmission of diseases. Vermicomposts are able to remove a considerable portion of pathogens. Passing diverse treatments from the earthworm's gut is effective on the microbial population available in different treatments. Decreased number of pathogens in vermicomposts' production process depends upon different factors including intestinal enzyme action of earthworms, coelomic

fluid secretion which has antibacterial properties as well as the competition between different groups of microorganisms.

Results of the current study showed that in the produced vermicomposts, mean fecal coliform has the highest and lowest values in centers 3 and 6, respectively. Also, results indicated that the mean parasite egg has the highest and lowest values in centers 1 and 10, respectively; such a difference may be due to change in process. In center 6, prior to start the process, animal fertilizers were washed and mixed with barley sprouts.

In the study conducted by Farzad Kia et al., on microbial quality of the compost fertilizer produced in Compost factories of Tehran and Khomein, the results indicated that the products of the two factories are in Class B of compost; this result is not in line with present study. However, in another study carried out by Amouei et al., entitled as "an assessment on quality of the compost produced from rural wastes in Babol city", the results showed that their produced fertilizer is in the Class A of American Compost, while this result is consistent with findings of the present work [5]. The results of LG Rodriguez on decreased number of pathogens in septic tank sludge at the vermicomposts production process are in parallel with those of present study based on which the pathogens decreased considerably and were in specified standard level [12]. Manuel Aira et al., conducted a study on decrease of pathogens in cow manure and their results indicated that fecal coliform has not reached EPA standard which is inconsistent with results of present study [7]. Subrataitail reported that pathogens considerably decreased in the final product of vermicomposts derived from primary sewage sludge and they were lower than the limit determined by USEPA. Therefore, this result is in line with those found in present study [13]. Also, in the study conducted by Karimi et al., the results showed that number of fecal coliforms in the vermicomposts derived from mixture of cow manure, sludge, and wastes did not reach standards determined by different organization and thus this result is inconsistent with those obtained here [8].

Conclusion

Production of vermicomposts from animal fertilizers in Yazd not only decreases such wastes but also leads to manufacture a strategic and valuable product which is in the specified standards level in terms of microbial quality and is suitable for the soil fertility and improvement.

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Conflict of interest

We have no competing interests.

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