An Experimental Study of Vermicomposting with Earthworm (*Eisenia Foetida*) Growth in Edible Mushrooms Wastes

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Abstract

Every year mushroom wastes are produced in big volumes from edible mushroom production industries. Vermicomposting technology is using earthworms as versatile natural bioreactors for effective recycling of organic wastes of the soil and an environmentally acceptable means of converting waste into nutritious composts for crop production. This study was undertaken to use earthworms (*Eisenia foetida*) in vermicomposting on edible mushroom's wastes. The Randomized block design with three treatments in Kimia, Sabalan and Artashahr mushroom production industries were selected and four replications were applied for treatments. The total biomass of earthworms was estimated by counting the number of adults, juveniles and cocoons from each replication .The number of adult and mature worms, egg capsules and wet weight of earthworms were recorded in one month intervals (totally in five months). Vermicomposting carried out by these worms in four months in spite of delay in their establishment in mushroom wastes. The worms wet weight, their number and the number of capsules were increased up to fourth month and then decreased. The produced vermicompost had suitable properties for amending soil.

1. Introduction

Human population growth is accompanying with the increased production of different wastes (Loh et al., 2005). Organic wastes disposal is a critical problem in human and environment health. With the increasing need to conserve natural resources and energy, recycling of organic wastes assumes major importance (Bansal & Kapoor, 2000). A big volume of agricultural wastes such as poultry urine is produced during edible mushroom production process (Sample et al., 2001). This can pollute ground water and cause another problem in case of their mismanagement. Edible mushroom production is increasing, as example; 14 million tonnes were produced only in china in 2006 (Chang, 2006). For producing one kilograms of edible mushrooms, one needs about five kilograms compost urine. Since the remained compost will contain high percent of salt, unfavorable organic matters (Sample et al., 2001), high percent of chuck and alkaline properties (Tajbakhsh et al., 2008), it is not suitable for using it in greenhouses soil amending. One of the best solutions for such problem is converting it to valuable matters. Vermicomposting uses earthworms to turn organic wastes into very high quality compost. Vermicomposting technology using earthworms is as versatile natural bioreactors for effective recycling of organic wastes to the soil and an environmentally acceptable means of converting waste into nutritious composts for crop production. Vermicompost is homogenous, with desirable aesthetics, plant growth hormones and high levels of soil enzymes, while enhancing microbial populations and tending to hold more nutrients over longer periods without adverse impacts on the environment. It can also be used as a bioremedial measure to reclaim problem soils, especially acid soils, because of the near-neutral to alkaline pH of vermicompost and the suppression of labile aluminium (Edwards, 1998). Earthworms have been long recognized by farmers as beneficial to soil and, as one of the major soil macro fauna, constitute an important group of secondary decomposers. Earthworms are key biological agents in the degradation of organic wastes. Earthworms was used to turn organic sludge into organic compost (Dominguez et al., 2000). He showed that sludge mixing with another material and using *Eisenia foetida* cause considerably declined in pathogenic microorganism populations. Because of highly toxic metals in industrial units, vermicomposting was not possible. Edwards (1980) investigated the earthworm application possibility in agricultural and animal waste recycling. The results indicated that cow dung was the best usual environment for earthworm growth but this reached the highest point using pig manure. He explained that inorganic substances, heavy metals (especially Cu) and ammonia are the prominent problems that will be seen. Other studies showed that horse manure, poultry manure, potato's wastes, bars industry's wastes, mushroom industries wastes and municipal wastes are suitable for vermicomposting (Edwards 1998). There is little investigation about vermicomposting via edible mushrooms wastes. Tajbakhsh et al., (2008) measured chemical properties of vermicompost which produced from mushroom industries wastes and explained that vermicomposting is favorable tools for its recycling.

2. Materials and Methods

For earthworm (*E. foetida*) growth possibility investigation in edible mushroom wastes and vermicomposting , three treatments in three replication were selected in Kimia, Sabalan and Artashahr mushroom production industries. All samples were investigated in Islamic Azad University-Ardebil Branch 's Investigation Station Greenhouse.

After the establishment of flower pots containing mushroom wastes, they were kept moist throughout the experiment by regular watering. After one week, ten worms were added to each flower pot and no worm survived after that week. After which, ten worm was added again and the same result was obtained. Again ten new worms was added and observed that 2-4 worms survived in each except three treatments. Ten another worms was added to treatments and 100 worms was laid in samples which had more than six alive worm. After one month 100 worms was added to previous treatments (which contained 100 worms), wastes conversion possibility were investigated. The number of adult and immature worms, the number of capsules and the worms wet weight were recorded in one month intervals (one, two, three, four and five months). One way Analysis of Variance (One way ANOVA) and mean comparison with Duncan's Test were carried out with MSTATC software.

3. Results and Discussion

The results of One-way ANOVA for biological parameters of the earthworms including their number, the number of cocoons, worms weight in the final vermicompost are showed in the Table 1, 3 and 6. With regard to the results obtained from ANOVA, it can be seen that the number of worms, their weight and cocoons number in different treatments and times was significant (p<0.01). Mean difference analysis result for mushroom waste degradation time effect on biological properties of the worms was presented in the Table 5. As can be seen, the number and weight of the worms and the number of cocoons was increased significantly.

In spite of earthworm growth in mushroom waste containing flower pots, mean comparing showed that the most favorable mushroom waste was belonged to Sabalan and Kimia mushroom wastes, which this relate probably to their chemical properties (Table 2, 4, 7 and 8).

Temperature monitoring during time showed that the internal temperature reach to 20°C and fixed during third month, but lowered during fourth month and reached the lowest point in

Table 1: Analysis of variance for the temperature of samples in different treatments and different time measurements

Sources of variation	Freedom of degree	Temperature	Number of worm
Treatment	2	0.358^{ns}	31588.04^{**}
Month	7	178.20^{**}	8897.88^{**}
Treatment×Month	14	0.435^{ns}	12816.72^{ns}
Replication	3	0.773^{*}	2594.89^{ns}

ns: non-significant, *significant (0.01<p<0.05), **significant (p<0.01)

Table 2: Mean comparison of the temperature and the number of Worms

Treatment	Temperature	Mean of worm number
Sabalan	15.81^{a}	119.88^{a}
Arta	16.025^{a}	69.94^{a}
Kimiya	15.95^{a}	127.94^{a}

Table 3: The results of ANOVA for weight worms in treatments and measurements times

Sources of variation	Freedom of degree	Weight worms
Treatment	2	1742.50^{**}
Month	3	2840.95^{**}
Treatment×Month	6	451.84^{**}
Replication	3	$437/05^{**}$
Error	36	685.87

**significant (p<0.01)

Table 4: Mean comparison of the worms' weight in deferent treatments

Treatment	Temperature
Sabalan	62.86^{a}
Arta	46.44^{a}
Kimiya	62.36^{a}

Table 5: Mean comparison of the worms' weight on deferent times

Month	Mean of weight worms
1	35.09^{a}
2	66.56^{a}
3	70.03^{a}
4	67.36^{a}
5	47.06^{a}

Table 6: ANOVA cocoon number in treatments and different time measurements		
Sources of variation	Freedom of degree	Weight worms
Treatment	2	65386.08**
Month	2	98809.75**
Treatment×Month	4	12732.2**
Replication	3	820.69**
Error	24	3326.17
ns: non-significant, **significant (p<0.01)		

Table 4: Mean comparison of cocoon number in treatments	
Treatment	Temperature
Sabalan	170.67[a]
Arta	33.83[b]
Kimiya	150.25[a]

Table 5: Mean comparison of cocoon different time measurements	
Month	Mean of weight worms
1	14.33[b]
2	158.58[a]
3	181.83[a]

the last month (Table 2). Some investigators uses different kind of material to increase the volume of sludge vermicomposting, such as paper wastes, olive foliage (Manios and Stenifored, 2006), water hyacinth (Vigueros et al., 2002), sugare cane baggas, saw dust, wood residuals (Maboeta and van Rensburg, 2003). There was no investigation about earthworm's biological indices in vermicomposting from mushroom wastes. It had been showed that in the vermicomposting process from mushroom wastes, PH, EC, Organic carbon, C/N, Potassium and Sodium percent were decreased and the other final elements concentration were increased. So such vermicompost is suitable for soil amending.

4. Conclusion

Mushroom compost wastes without suitable treatment will result in environmental pollution. The study indicated that *E. foetida* can actively work in mushroom wastes which can be used this process as tools for waste management and soil amendment.

5. Acknowledgements

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