Journal of Anatolian Environmental and Animal Sciences
(*Anadolu Çevre ve Hayvancılık Bilimleri Dergisi*)
DOI: https://doi.org/10.35229/jaes.1364384

JAES
Year: 8, No: 4, 2023 (658-663)
AÇEH
Yıl: 8, Sayı: 4, 2023 (658-663)

ARAŞTIRMA MAKALESİ RESEARCH PAPER

Determining the effects of feeding *Eisenia fetida* with Oyster Mushroom Waste and Brewed Tea Waste on the Development of It and Some Nutrients in Vermicompost

Turan YÜKSEK **Servet ÇELTEK***
Faculty of Engineering and Architecture, Department of Landscape Architecture, Recep Tayyip Erdogan University, 53020 Rize, Türkiye

Geliş/Received: *21.09.2023* ***Kabul/Accepted:*** *21.11.2023* ***Yayın/Puplished:*** *31.12.2023*

How to cite: **Yüksek, T. & Çeltek, S. (2023).** Determining the effects of feeding *Eisenia fetida* with Oyster Mushroom Waste and Brewed Tea Waste on the Development of It and Some Nutrients in Vermicompost. *J. Anatolian Env. and Anim. Sciences*, ***8***(4), 658-663. https://doi.org/10.35229/jaes.1364384
Atıf yapmak için: **Yüksek, T. & Çeltek, S. (2023).** *Eisenia fetida*'nın İstiridye Mantarı Atığı ve Demlenmiş Çay Atığı ile beslenmesinin vermikomposttaki gelişimi ve bazı besin maddeleri üzerine etkilerinin belirlenmesi. *Anadolu Çev. ve Hay. Dergisi*, ***8***(4), 658-663. https://doi.org/10.35229/jaes.1364384

*: https://orcid.org/0009-0009-3312-6543
: https://orcid.org/0000-0003-2964-1760

***Corresponding author's:**
Servet ÇELTEK
Faculty of Engineering and Architecture, Department of Landscape Architecture, Recep Tayyip Erdogan University, 53020 Rize, Türkiye
✉: servet_celtek19@erdogan.edu.tr

Abstract: The aim of this study is to determine the effects of feeding *Eisenia fetida* with oyster mushroom waste (OMW) and brewed tea waste (BTW) on the growth it and some nutrients in fertilizer. For this purpose, three different growing media including OMW (100%) (T1), OMW (50%) + (BTW) (50%) (T2), OMW (25%) + BTW (75%) (T3) were used in the experiments. The research was carried out in plastic containers with a width of 40 cm x 40 cm length x 20 cm in accordance with the randomized plot design in three repetitions. The changes of some nutrients in solid and liquid vermicompost obtained from different quality nutrient media were made by Anova and Variance analysis and multiple comparisons between the nutrient media were made by Duncan test. As a result of the study, the number of worms in all growing media decreased over time. The highest reduction was 31.10% in OMW (25%) + BTW (75%) in the nutrient medium. As a result of the study, the highest Ca, Na, K, Mg values were found in untreated Oyster mushroom (control) waste, while the highest Fe value was found in solid vermicompost obtained from oyster mushrooms (100%) in T1. The highest Zn value was obtained from solid vermicompost obtained from the mixture of OMW (50%) + BTW (50%) in treatment T2. The highest Cu and Mn values were found in the solid vermicompost obtained from the OMW (25%) + BTW (75%) mixture in T3, and the changes were statistically significant. It can be said that the physico-chemical properties of the growing medium and other environmental factors are effective in the *Eisenia fetida* population changes in the different waste materials.

Keywords: brewed tea, *Eisenia fetida*, oyster mushroom, recycling, vermiwash.

Eisenia fetida'nın İstiridye Mantarı Atığı ve Demlenmiş Çay Atığı ile beslenmesinin vermikomposttaki gelişimi ve bazı besin maddeleri üzerine etkilerinin belirlenmesi

***Sorumlu yazar:**
Servet ÇELTEK
Mühendislik-Mimarlık Fakültesi, Peyzaj Mimarlığı Bölümü, Recep Tayyip Erdoğan Üniversitesi, 53020 Rize, Türkiye
✉: servet_celtek19@erdogan.edu.tr

Öz: Bu çalışmanın amacı İstiridye mantarı atığı ve demlenmiş çay atığı ile beslemenin *Eisenia fetida* gelişimi ve gübredeki bazı besin elementlerine etkisinin belirlenmesidir. Araştırma tesadüf parselleri deneme desenine uygun olarak 40 cm boy x 25 cm en x 20 cm derinliğinde plastik kaplarda üç tekrarlamalı olarak yürütülmüştür. Bu amaçla İstiridye mantarı atığı (%100) (T1), İstiridye mantarı atığı (%50) + demlenmiş çay atığı (%50) (T2), İstiridye mantarı atığı (%25) + demlenmiş çay atığı (%75) (T3) olmak üzere üç farklı yetiştirme ortamı kullanılmıştır. Besi ortamlarındaki solucan sayı ve ağırlığındaki değişimler 13 hafta süresince haftada birkez tespit edilmiştir. Farklı kalitedeki besin ortamlarından elde edilen katı ve sıvı solucan humusundaki bazı besin maddelerinin değişimleri Anova ve Varyans analizi ile, besin ortamları arasında çoklu karşılaştırmalar ise Duncan testi ile yapılmıştır. Çalışma sonucunda tüm yetiştirme ortamlarında solucan sayıları zamanla azalmıştır. En yüksek azalma %31,10 ile İstiridye mantarı (%25) + demlenmiş çay atığı (%75) besin ortamında meydana gelmiştir. Çalışma sonucunda en yüksek Ca, Na, K, Mg değerleri işlenmemiş istiridye mantarı (kontrol) atıklarında bulunurken, en yüksek Fe İstiridye mantar atığından (%100) (T1) elde edilen katı solucan gübresinde, en yüksek Zn miktarına İstiridye mantarı (%50)+ denlenmiş çay atığı (%50) karışımından elde edilen katı solucan gübresinde rastlanmıştır. Farklı besi ortamlarından elde edilen katı solucan gübresindeki Cu ve Mn değerleri arasındaki değişim istatistiksel olarak ($p<0.000$) önemli seviyededir. Farklı besi ortamlarının sahip olduğu fiziko kimyasal özellikler ve solucan yetiştirme ortam özelliklerinin solucan gelişimi, solucan sayısı ve solucan ağırlığında etkili olduğu söylenebilir.

Anahtar kelimeler: Demlenmiş çay atığı, *Eisenia fetida*, geri dönüşüm, oyster mushroom, solucan suyu.

INTRODUCTION

The population worldwide has reached 7.99 (URL-1) billion and continues to increase rapidly. The world population will reach 8.5 billion in 2030, 9.7 billion in 2050, and 10.4 billion in 2100 (URL-2). It is predicted that 68 % of the world population will live in urban areas (URL-3). Improved agricultural practices and rapid industrialization and population growth have led to huge waste generation, and the management of this waste is becoming a global concern (Vyas et al., 2022). It is stated that 50-80% of the wastes produced in many cities in developing countries can be collected and 20-50% of their budgets are spent for the collection of these wastes (Guerro et al., 2013; Worldbank, 2018). It is stated that in underdeveloped and low-income countries, only 10% of the garbage produced in suburban areas of most cities can be collected, and the cases of people living in the vicinity of non-collected dumps, especially diarrhea, skin diseases and acute respiratory infections continue to increase (Prakash, 2017). In addition global wastes cause pollution of soil and water resources; On the other hand, it continues to negatively affect the sustainability of different ecosystems and human life. Especially leaving domestic wastes in the environment as garbage in this way causes significant economic losses as well as environmental problems. Recycling of domestic organic wastes around the world with the vermicompost technique, the cost of garbage collection in cities and rural areas can be reduced. On the other hand, the wastes can be recycled to products with economic and ecological value (solid and liquid vermicompost, plant grower and developer, plant protector, earthworm, flour, etc.) can be converted.

The hypothesis of this research (Ho): Vermicompost technique has no effect on the recovery of organic domestic waste. The objectives of this study were to determine worm growth in Oyster mushroom waste (100%) (i), in Oyster mushroom waste (50%) + brewed tea waste (50%) (ii), and in Oyster mushroom waste (25%) + brewed tea waste (75%) (iii) growing mediums and to determine some nutrients in the vermicompost and vermiwash obtained different waste materials. The aim of this study is to determine the effects of feeding *Eisenia fetida* with oyster mushroom waste and brewed tea waste on the growth of it and some nutrients in fertilizer.

MATERIAL AND METHOD

Material: *Pleurotus ostreatus* mushroom wastes used in the experiments were obtained from Ağaran Mushroom production company. *Eisenia fetida* (red California worm) used in the experiments were provided by Turan Yüksek's worm research laboratory. The brewed tea wastes were obtained from the RTEU Faculty of Engineering and Architecture teahouse. Plastic feeding cups and shading cover used in the experiments were purchased from the market.

Method

Preparation of the media: Oyster mushroom wastes used in the experiments were physically shredded by hand. The waste water accumulated in the tea wastes was filtered and taken from the nutrient medium.

Trial Design: Three different growing media including Oyster mushroom waste (OMW) (100%) (T1), Oyster mushroom waste (50%) + (50%) brewed tea waste (BTW) (T2), OMW (25%) + BTW (75%) (T3) were used in the experiments. The research was carried out in plastic containers with a width of 40 cm x 40 cm length x 20 cm in accordance with the randomized plot design in three repetitions. In accordance with the experimental design, the feeding media with a weight of approximately 2 kg were placed in the plastic containers and watered with tap water until the moisture level in the medium reached 50%, and then 30 *Eisenia fetida* worms, whose weights were determined, were placed in the containers. The number and weight of worms in the medium were determined once a week for 13 weeks. At the end of 13 weeks, the digestibility and color changes of the feeding materials where the worms were placed were controlled and after the fertilizer formation was completed, the solid and liquid fertilizers in the medium were harvested.

Data analysis: The changes of some nutrients in solid and liquid vermicompost obtained from different quality nutrient media were made by Anova and Variance analysis and multiple comparisons between the nutrient media were made by Duncan test. The data obtained as a result of the research were converted into tables and graphics. SPSS-23 package program was used for statistical analysis.

RESULTS

Changes in the number and weight of worms in different growing mediums: Worm number and weights in growing medias OMW (100%), OMW (50%) + BTW (50%), and OMW (25%) + BTW (75%) decreased over time (Fig.1, 2, 3).

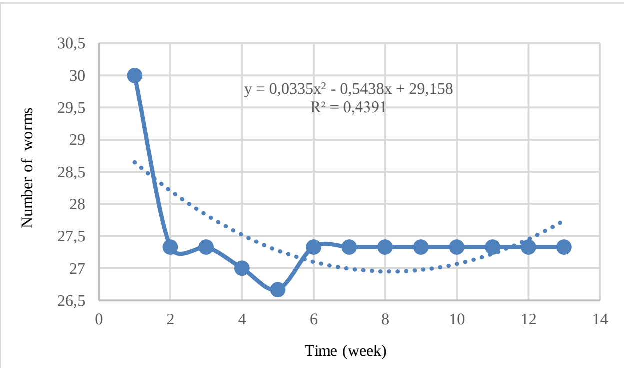

Figure 1. Change in the mean worm number in Oyster mushroom waste (100%) over time.

As a result of the research, OMW (100%), OMW (50%) + BTW (50%), OMW (25%) + BTW (75%) mean worm weights increased (Fig. 4, 5, 6). The highest increase in worm weight was 44.26% in OMW (50%) + BTW (50%) in growing medium, while the minimum worm weight gain was 30.86% in OMW waste (25%) + BTW (75%) growing medium.

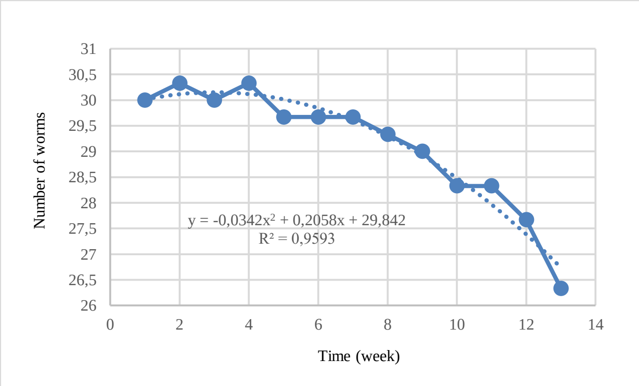

Figure 2. Change in the mean worm number in Oyster mushroom waste (50%) and brewed tea waste (50%) over time.

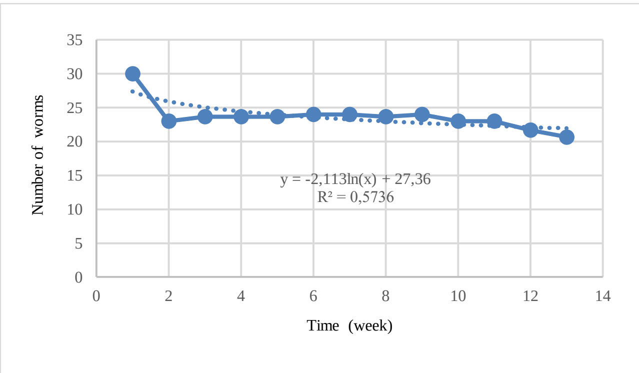

Figure 3. Change in the mean worm number in Oyster mushroom waste (25%) and brewed tea waste (75%) over time.

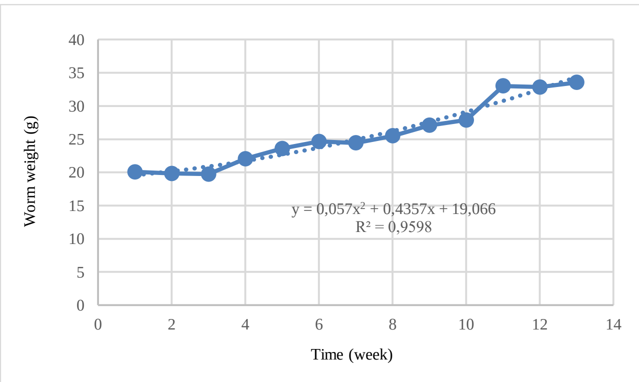

Figure 4. Change in the mean worm weight in OMW (100%) over time.

Change of some nutrients in vermicompost and vermiwash obtained from different feeding materials: As a result of the study, the highest Ca, Na, K, Mg values were found in untreated oyster mushroom (control) waste, while the highest Fe value was found in solid vermicompost obtained from oyster mushrooms (100%) in T1. The highest Zn value was determined in solid vermicompost obtained from the mixture of OMW (50%) + BTW (50%) in treatment T2. The highest Cu and Mn values were found in the solid vermicompost obtained from the OMW (25%) +BTW (75%) mixture in T3, and the changes were statistically significant (Table 1).

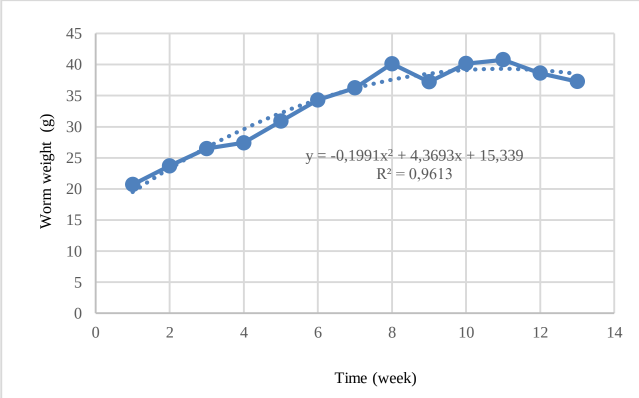

Figure 5. Change in the mean worm weight in OMW (50%) and BTW (50%) over time.

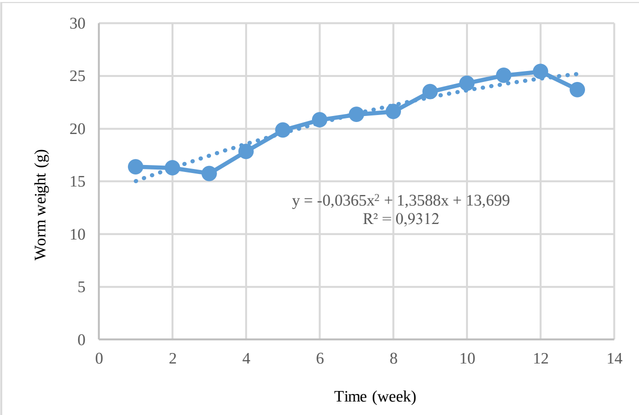

Figure 6. Change in the mean worm weight in OMW (25%) and BTW (75%) over time.

The lowest Cu and Mn values were found in the untreated oyster mushroom (control), while the lowest Ca and Mg values were determined in solid vermicompost obtained from oyster mushrooms (100%) (T1). The lowest Zn value were found in the solid vermicompost obtained from the mixture of OMW (control), while the lowest Fe, Na and K values were found in the solid vermicompost obtained from the mixture of OMW (25%) + BTW (75%) (T3) and the changes were statistically significant (Table 1).

As a result of the research, the highest Ca, Mg, Na, Cu, Zn, and K values in vermiwash obtained from different nutrient media were found in liquid vermicompost produced from OMW (100%) (T4). The highest Mn values were found in T5, while the highest Fe was found in T6. It was determined that the changes in Ca, Zn, Mn and Mg values in liquid vermicompost obtained from different media was statistically significant (p<0.000) (Table 2).

Table 1. Changes of some nutrients in solid vermicompost obtained in different Feeding Materials.

Feeding Materials	Par.	N	Mean	Std.Dv	F	p
Control		4	$9,68^{b}$	0,0608		
OMW (100%) (T1)	Fe	9	$12,77^{a}$	0,2753	8,131	0,000
OMW (50%)+BTW (50%) (T2)		16	$9,67^{b}$	2,490		***
OMW (25%) +BTW (%75) (T3)		12	$9,22^{b}$	1,430		
Control		4	$0,484^{b}$	0,0061		
OMW (100%) (T1)	Zn	9	$0,554^{a}$	0,0284	8,835	0,000
OMW (50%)+BTW (50%) (T2)		16	$0,575^{a}$	0,0431		***
OMW (25%) +BTW (%75) (T3)		12	$0,545^{a}$	0,0191		
Control		4	$0,125^{b}$	0,0021		
OMW (100%) (T1)	Cu	9	$0,129^{b}$	0,0022	19,69	0,000
OMW (50%)+BTW (50%) (T2)		16	$0,186^{a}$	0,0401		***
OMW (25%) +BTW (%75) (T3		12	$0,203^{a}$	0,0099		
Control		4	$0,836^{c}$	0,0083		
OMW (100%) (T1)	Mn	9	$0,879^{c}$	0,0127	24,167	0,000
OMW (50%)+BTW (50%) (T2)		16	$13,18^{b}$	1,859		***
OMW (25%) +BTW (%75) (T3		12	$17,13^{a}$	1,2418		
Control		4	$348,65^{a}$	7,098		
OMW (100%) (T1)	Ca	9	$144,44^{b}$	55,27	59,650	0,000
OMW (50%)+BTW (50%) (T2)		16	$167,66^{b}$	12,76		***
OMW (25%) +BTW (%75) (T3		12	$155,12^{b}$	8,47		
Control		4	$27,70^{a}$	0,3296		
OMW (100%) (T1)	Na	9	$15,40^{b}$	0,6121	270,69	0,000
OMW (50%)+BTW (50%) (T2)		16	$13,29^{c}$	1,3386		***
OMW (25%) +BTW (%75) (T3		12	$12,60^{c}$	0,6443		
Control		4	$98,38^{a}$	0,7417		
OMW (100%) (T1)	Mg	9	$42,42^{b}$	2,1726	245,69	0,000
OMW (50%)+BTW (50%) (T2)		16	$44,22^{b}$	5,2860		***
OMW (25%) +BTW (%75) (T3		12	$43,09^{b}$	2,8562		
Control		4	$366,17^{a}$	0,6551		
OMW (100%) (T1)	K	9	$153,87^{b}$	9,1827	286,347	0,000
OMW (50%)+BTW (50%) (T2)		16	$155,73^{b}$	19,254		***
OMW (25%) +BTW (%75) (T3		12	$147,57^{b}$	8,9116		

OMW: Oyster Mushrooms Waste; BTW: Brewed Tea Waste; T1: treatment 1; T2: Treatment 2; T3: Treatment 3; Par: Parameters, N: Number of Samples, Mean: Average, Std. Dv: Standard Deviation, p: Significance Level, ***: P <0.000

Table 2. Changes of some nutrients in vermiwash obtained in different growing medium.

Feeding Materials	Par.	N	Mean	Std.Dv	F	p
OMW (100%) (T4)		8	0,5082	0,2114		0,130
OMW (50%)+BTW (50%) (T5)	Fe	12	0,2627	0,1555	2,191	N.S
OMW (25%)+BTW (75%) (T6)		12	0,7464	0,8897		
OMW (100%) (T4)		8	$0,0537^{a}$	0,0023		0,000
OMW (50%)+BTW (50%) (T5)	Zn	12	$0,0395^{b}$	0,0070	34,516	***
OMW (25%)+BTW (75%) (T6)		12	$0, 0358^{b}$	0,0029		
OMW (100%) (T4)		8	$0,0123^{a}$	0,0005		0,015
OMW (50%)+BTW (50%) (T5)	Cu	12	$0,0095^{b}$	0,0038	4,838	N.S
OMW (25%)+BTW (75%) (T6)		12	$0,0083^{b}$	0,0026		
OMW (100%) (T4)		8	$0,0927^{b}$	0,0139	17,159	0,000
OMW (50%)+BTW (50%) (T5)	Mn	12	$1,3322^{a}$	0,7332		***
OMW (25%)+BTW (75%) (T6)		12	$0,3975^{b}$	0,3738		
OMW (100%) (T4)		8	$31,45^{a}$	0,8631	17,851	0,000
OMW (50%)+BTW (50%) (T5)	Ca	12	$20,06^{b}$	4,5853		***
OMW (25%)+BTW (75%) (T6)		12	$18,71^{b}$	6,6160		
OMW (100%) (T4)		8	13,09	1,1479	0,346	0,710
OMW (50%)+BTW (50%) (T5)	Na	12	12,56	1,5398		N.S
OMW (25%)+BTW (75%) (T6)		12	13,04	1,9538		
OMW (100%) (T4)		8	$17,87^{a}$	1,564	12,563	0,000
OMW (50%)+BTW (50%) (T5)	Mg	12	$14,13^{b}$	2,282		***
OMW (25%)+BTW (75%) (T6)		12	$13,61^{b}$	1,869		
OMW (100%) (T4)		8	102,61	12,31	1,391	0,265
OMW (50%)+BTW (50%) (T5)	K	12	94,14	11,45		N.S.
OMW (25%)+BTW (75%) (T6)		12	91,97	17,83		

OMW: Oyster Mushrooms Waste; BTW: Brewed Tea Waste; T1: treatment 1; T2: Treatment 2; T3: Treatment 3; Par: Parameters, N: Number of Samples, Mean: Average, Std. Dv: Standard Deviation, p: Significance Level, ***: P <0.000

DISCUSSION

It can be said that the physico-chemical properties of the growing medium and other environmental factors are effective in the *Eisenia fetida* population changes in the different waste materials. The decrease rates in the number of worms in the nutrient media over time are 8.9% in OMW (100%) media, 12.33% in OMW (50%) + BTW (50%), and in OMW (25%) + BTW (75%) was 31.10%. This shows that the physico-chemical properties of the growing medium are effective in the development of worms in the waste materials. As a matter of fact, Yüksek et al. (2019) found in their study that the number of worms fed in the brewed tea waste (100%) medium decreased by 16.30% ; while the number of worms in the brewed tea waste (50%) + food waste (50%) medium decreased by 33.73%. They found that the number of worms increased by 6.25% in brewed tea waste (50%) + cow manure (50%) mixtures. In another study, Yüksek (2019) showed that the number of worms decreased by 49,5% in the hazelnut waste (50%) + and tea fiber (50%) growing medium; while the number of worms increased by 14.65% in the mixture of 20% hazelnut husk + sawdust (15%) + newspaper paper (5%) growing medium. Yüksek and Çemberi (2022) found that the number of worms in the municipal waste sludge (100%) growing medium increased by 3.75%; while the number of worms decreased by 46.63% in waste sludge (50%) + clay soil (50%) growing media. It is stated that the physico-chemical properties of the growing medium, the mixture ratios of the growing medium and environmental conditions are very effective in the change of the worm population (Homan et al., 2016; Yüksek, 2019; Yüksek et al., 2019; Wu et al., 2020; Yüksek & Çemberci, 2022). It is stated that the media used for feeding worms are not fully composed and the excess mineral matter and nitrogen content in their environment may adversely affect the growth of worms (Yüksek & Çemberci, 2022; Yüksek & Soyyiğit, 2023). It is also stated that the amount of ammonium released during the vermicomposting process and temporary changes in environmental pH may be effective in worm population change (Gunadi & Edwards, 2003). It is thought that the chemicals used to kill invasive herbs in tea gardens where brewed tea wastes used in worm feeding may adversely affect the development of worms due to their toxic properties. It is stated that pesticide application has a negative effect on the growth and reproduction of worms (Yasmin & D'Souza, 2007; Jovana et al., 2014; Miglan & Bisht, 2019; Ilıkhan & Koç, 2020). At the end of the vermicomposting process, the amounts of Fe, Zn, Cu and Mn in the solid vermicompost obtained from different nutrient media increased statistically significantly, while the amounts of Ca, Na, Mg, K decreased significantly. It can be concluded that during the vermicomposting process, the micro and macro nutritional elements in the media change depending on the amount of micro and macro nutrients in the media used to feed worms, whether the media are pure or mixed, and the enzymatic activity created by these media in the worm intestine. It is stated that some macro and micro nutrients in the solid vermicompost obtained as a result of the vermicomposting process in different nutrient media used in worm feeding vary depending on the mixture and the physico-chemical properties of the mixture (Garg et al., 2006; Yüksek, 2019; Yüksek et al., 2017; Yüksek et al., 2019; Mohammed et al., 2022).

CONCLUSION AND RECOMMENDATIONS

The type of waste materials used in the vermicomposting of domestic organic wastes, the waste mixture ratio, the physico-chemical properties of the wastes, whether pre-treatment is applied before vermicomposting or not effective in changing the worm population and the properties of the obtained vermicompost. By popularizing the vermicomposting of domestic organic waste at home or on the site, it can reduce the collection and transportation costs of domestic waste. On the other hand, it can provide great benefits to environmental protection and sustainable environmental management by transforming domestic wastes into products with an economic value.

ACKNOWLEDGEMENTS

This study was supported by the Scientific and Technical Research Council of Turkey with project number 2209-A 1919B012207703. We thank TÜBİTAK for their support. We would like to thank to Dr. Filiz Yüksek for her contributions to the statistical tests of the manuscript.

REFERENCES

URL-1: https://www.census.gov/popclock (accessed on 8 August 2023).

URL-2: https://www.un.org/en/global-issues/population **(**accessed on 8 August 2023).

URL-3: https://www.un.org/uk/desa/68-world-population-projected-live-urban-areas-2050-says-un (accessed on 8 August 2023).

World Bank Solid Waste Management. (2018). Available online: http://www.worldbank.org/en/topic/urbandevelopment/brief/solid-waste-management **(**accessed on 8 August 2023).

Garg, P., Gupta, A. & Satya, S. (2006). Vermicomposting of different types of waste using *Eisenia foetida*: A comparative study. *Bioresource technol*. ***97***(3), 391-395.

Guerrero, L.A., Maas, G. & Hogland, W. (2013). Solid waste management challenges for cities in developing countries. *Waste Management*, ***33***, 220-232. DOI: 10.1016/j.wasman.2012.09.008

Gunadi, B. & Edwards, C. A. (2003). The effects of multiple applications of different organic wastes on the growth, fecundity and survival of *Eisenia fetida* (Savigny) *(Lumbricidae)*. *Pedobiologia*, ***47***(4), 321-329.

Homan, C., Beier, C., Mccay T. & Lawrence, G. (2016). Application of lime ($CaCO_3$) to promote forest recovery from severe acidification increases potential for earthworm invasion. *Forest Ecology and Management*, ***368***, 39-44. DOI: 10.1016/j.foreco.2016.03.002

Ilıkhan, B. & Koç, İ. (2020). Some biological parameters of *Eisenia fetida* (Savigny, 1826) in pesticide-applied vermicompost. *KSU J. Agric. Nat*. ***23***(2), 366-377. DOI: 10.18016/ksutarimdoga.vi.571851

Jovana, M., Tanja, M. & Mirjana S. (2014). Effects of three pesticides on the earthworm Eisenia fetida (Savigny 1826) under laboratory conditions: Assessment of mortality, biomass and growth inhibition. *Eur. J. Soil Biol.* ***62,*** 127-131. DOI: 10.1016/j.ejsobi.2014.03.003

Miglan, R. & Bisht, S.S. (2019). World of earthworms with pesticides and insecticides. Interdiscip Toxicol. ***12***(2), 71-82. DOI: 10.2478/intox-2019-0008

Mohammed, A.R., Kuştaş, S. & Yüksek, T. (2022). Literature Review: The role of earthworms in bioremediation of treated wood. *Wood Indus. and Eng*. ***4***(1), 16-31.

Prakash, S. (2017). Solid waste management and its impact on public health: A Review. *IRE Journals*, 1700118, ***6***(1), 101-105.

Vyas, P., Sharma, S. & Gupta, J. (2022). Vermicomposting with microbial amendment: Implications for bioremediation of industrial and agricultural waste. *BioTechnologia*, ***103***(2), 203-215. DOI: 10.5114/bta.2022.116213

Yasmin, S. & D'Souza, D. (2007). Effect of pesticides on the reproductive output of *Eisenia fetida*. *Bull Environ. Contam. Toxicol*, ***79***, 529-532. DOI: 10.1007/s00128-007-9269-5

Yüksek, T., Verep, B. & Baltacı, C. (2017). Investigation of vermiwash obtained from california red worm which fed cow dung in terms of trace and nutrient elements. *Turkish Journal of Agriculture-Food Science And Technology*, ***5***(8), 986-991. DOI: 10.24925/turjaf.v5i8.986-991.1266

Yüksek, T. (2019). The effect of different type feeding materials on red California worm number and weight. *J. Anatolian Env. and Anim. Sciences*, ***4***(1), 1-6. DOI: 10.35229/jaes.477726

Yüksek, T., Atamov, V. & Türüt, K. (2019). Determination of some nutrient elements in solid vermicompost obtained from red California worm feeding with brewed tea waste and domestic food waste. J. *Anatolian Env. and Anim. Sciences*, ***4***(2), 263-271. DOI: 10.35229/jaes.586428

Yüksek, T. & Çemberci, B. (2022). Determination of the effect of worm fertilizer obtained from red California worm fed with a mixture of municipal waste and clay soil on the growth of *Daphne odora Thunb. 'Aureomarginata'*. *J. Anatolian Env. and Anim. Sciences*, ***7***(3), 314-322. DOI: 10.35229/jaes.1141535

Yüksek, T. & Soyyiğit, F. (2023). Hedera colchica (K.Koch) K.Koch bitki atıklarında *Eisenia fetida* solucanının gelişimi ve elde edilen solucan gübresinin plectranthus amboinicus (lour.) spreng bitkisinde bazı büyüme parametrelerine etkisinin tespit edilmesi. *D.Ü Ormancılık Dergisi*, ***19***(1), 189-206. DOI: 10.58816/duzceod.1278611

Wu, J., Ren, Z., Zhang, C., Motelica-Heino, M., Deng, T., Wang, H. & Dai, J. (2020). Effects of soil acid stress on the survival, growth, reproduction, antioxidant enzyme activities, and protein contents in earthworm *(Eisenia fetida). Environmental Science and Pollution Research*, ***27***(27), 33419-33428. DOI: 10.1007/s11356-019-04643-y