Treatment and valorization of olive mill wastes trough vermicomposting using *Eisenia andrei*

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Introduction:

Olive mill wastes represent a serious environmental problem mainly for their high organic load (Roig et al., 2006). Given this situation, several techniques and approaches have been proposed for OMWW management, leading to a number of possible recycling and valorization methods (Federici et al., 2009). Among others, biological methods such as composting and vermicomposting are of particular interest for their operational simplicity and capacity to convert OMWW into a high-quality fertilizer, rich in stabilized organic matter and nutrients for plants (Altieri and Esposito, 2010). The aim of the present study is treatment and valorization of olive mill wastes trough vermicomposting using *Eisenia andrei,* in order to reduce both (i) the concentration of phenolic compounds and (ii) the C/N ratio, so that our vermicompost presents a safety essential for its use as an organic amendment.

Material & Methods

Compost preparation: Four mixtures (each one 1000kg) based on olive mill wastes were prepared and pre-composted for one month: (M1) olive pomace, horse manure and wood chips imbibed with water; (M2) olive pomace, horse manure and wood chips imbibed with 25% of olive mill wastewater; (M3) two phase olive mill waste (alperujo) and wood chips; (M4) horse manure and wood chips imbibed with water.

Vermicompost preparation: Each pre-composted mixture was distributed on three mini-plots (5 m^2) which were inoculated with 3.6 kg of earthworms each mini-plot (Fig. 1B) and the evolution of phenolic compounds and C/N ratio were followed during 6 months of vermicomposting.

Figure 1A: View of the pilot plant with the 12 mini-plots containing the pre-composted mixtures.

Figure 1B: Surface inoculation of a mini-plot containing precomposted mixture with 3.6 kg of *E. andrei* biomass.

Total phenol content in different samples was calorimetrically estimated at 765 nm, using the Folin—Ciocalteu reagent (Folin and Ciocalteu 1927) and expressed as tyrosol equivalents (mg of tyrosol g-1 of vermicompost). The C/N ratio was determined by the method of Dumas (1831) through an elemental analyzer Thermo Finnigan EA 1112.

Results and discussion

After six months of vermicomposting, the reduction rate of total polyphenols reached 89% (M2 mixture) (Fig. 2.A). Ganesh *et al* (2009) noted that raw materials with high phenols fraction and lignin concentration (such as OP and OMWW) are not well adequate for growth and development of most species of earthworms. Besides, the chemical composition of the feed substrate has an important role in feed rate of earthworms (Suthar, 2008). Zenjari and

Nejmeddine (2001) attributed the decrease of phenol concentration to microbial bioconversion of phenolic compounds and their interaction with secondary metabolites, contributing to the biosynthesis of humic substances.

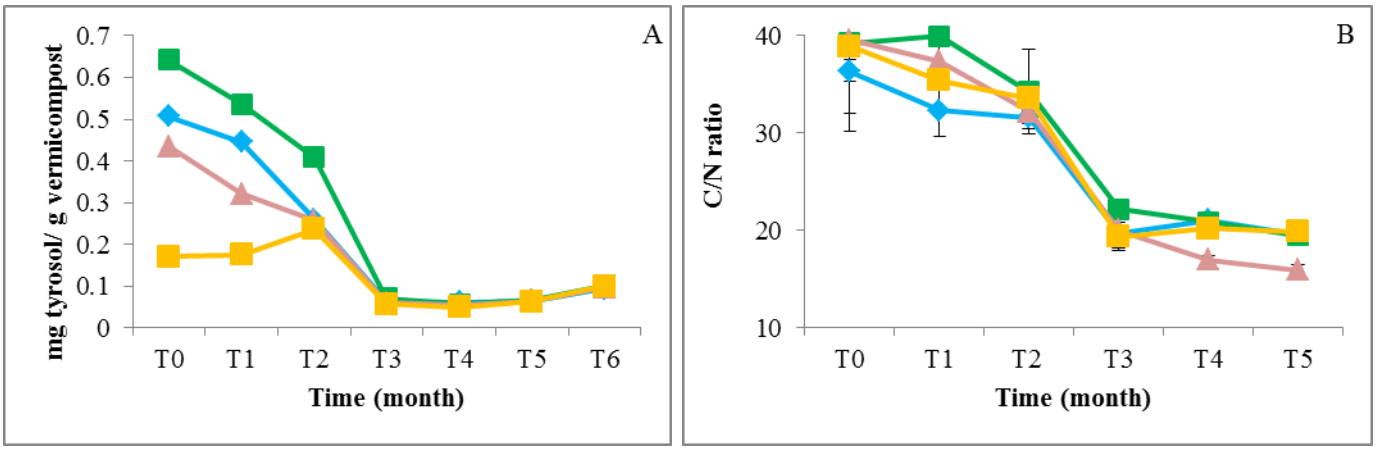

Figure 2: Evolution of total phenols (A) and C/N ratio (B) during vermicomposting in different mixtures M1 to M4; M1 M2 M3 M4 .

At the beginning of vermicomposting, the C/N ratio was between 34 and 39 in the mixtures M1 and M2 respectively. C/N ratio of the different mixtures decreased during vermicomposting to stabilize at values between 15.93 ± 0.6 for M3 and 19.89 ± 0.67 for M4 (Fig. 2.B). Decrease in C/N ratio can be attributed to carbon losses (Andersen et al., 2011) and combined action of earthworms and microorganisms which accelerate stabilization of organic matter by releasing carbon in form of carbon dioxide (Lim et al., 2011). Indeed, earthworms excrete nitrogen excreta and consequently increase nitrogen concentrations, thus reducing the C/N ratio (Lim et al., 2011).

Conclusion:

The results of this study support the potential of *Eisenia andrei* for bioconversion of olive by-products. Although OMWW is a recalcitrant organic by-product for decomposition, the combined action of earthworms and micro-organisms enhances its biodegradation. Additionally, vermicompost produced during our study can be used as organic amendment, because of reduction of total phenol and diminution of C/N ratio parameters that indicate a tendency to stabilizing of the organic matter during vermicomposting. Vermicomposting can be used as a feasible and less expensive alternative for the treatment and recovery of olive oil by-products.

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