Chemical, thermal, and spectroscopy assessment of different composts for the valorization of agricultural wastes in Southern Chile

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Abstract

The increase in the agricultural production generates an important amount of waste. Nowadays, composting is considered a sustainable process for reducing organic waste and recycling nutrients. Because of the variability of the organic wastes used in the composting process, there are different parameters to determine the stability, maturity and quality of the composts. The aim of this work was to evaluate the compost maturity and organic matter stability in three composts using various instrumental techniques. Different intra-farm residues were used for the compost elaboration: Sheep (C1-SH), Chicken (C2-CH) or Cow manure (C3-CW) with Oat straw and naturalized prairie (50:40:10% v/v). The composting process was performed using 200 L rotary bin for 90 days. Chemical (C/N ratio, CO_2 and NH_3 emission) and pathogen presence were performed to determine the maturity and quality of composts. Subsequently, a humic substances extraction (HA/FA) was carried out to study the stabilization degree by thermogravimetry (TG, DTG and DTA) and spectroscopy (UV-Vis and fluorescence) analysis. The composts evaluated were free of pathogens, showing a decrease of the C/N ratio, low CO_2 and null NH_3 emissions. Furthermore, a relationship between the highest temperature reached in each composting process and a higher stability and synthesis of stable polycondensed compounds, such as humic and fulvic substances was observed. This is associated with the presence of complex non-degradable thermal compounds in the composting process, decreasing the number of aromatic compounds with a high content of oxygen-rich polar functional groups. In conclusion, giving the characteristics of the composts generated, C1-SH was classified like as Class A according to Chilean Compost Standard which confirms that it is possible to generate a quality amendment being an alternative to valorize intra-farm agricultural waste. The evaluation of indicators for establishing criteria of maturity, degradation and stability of amendments is in close relation to the critical temperature reached in the process and that determine the quality of the final product. This research was supported by CONICYT REDI170645 Project.

Image

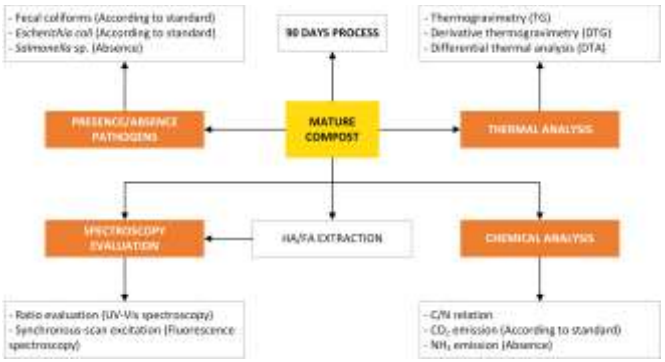


Figure 1. Summary scheme for the evaluation of the mature compost stability.

Recent Publications (minimum 5)

1. Aranganathan, L., Rajasree, S. R. R., Suman, T. Y., Remya, R. R., Gayathri, S., Jayaseelan, C., et al., Gobalakrishnan, M. (2019). Comparison of molecular characteristics of Type A humic acids derived from fish waste and sugarcane bagasse co-compost influenced by various alkaline extraction protocols. Microchemical Journal, 104038.
2. Curaqueo G, Sánchez-Monedero MÁ, Meier S, Medina J, Panichini M, Borie F, et al. (2016). Characterization of a soil amendment derived from co-composting of agricultural wastes and biochar. In: Geophysical Research Abstracts, vol 18, EGU2016-18184-1.
3. Guo, X., Liu, H. & Wu, S. (2019). Humic substances developed during organic waste composting: Formation mechanisms, structural properties, and agronomic functions. Science of the Total Environment, 662, 501–510.
4. Onwosi, C.O., Igbokwe, V.C., Odimba, J.N., Eke, I.E., Nwankwoala, M.O., Iroh, I.N. & Ezeogu, L.I. (2017). Composting technology in waste stabilization: on the methods, challenges and future prospects. J. Environ. Manag., 190, 140–157.
5. Soobhany, N., Gunasee, S., Pooja Rago, Y., Joyram, H., Raghoo, P., Mohee, R. & Kumar Garg, V. (2017). Spectroscopic, thermogravimetric and structural characterization analyses for comparing Municipal Solid Waste composts and vermicomposts stability and maturity. Bioresource Technology, 236, 11–19.



Biography

Gustavo Curaqueo is Agronomist with a Doctorate in Natural Resources Sciences. His lines of interest are Soil Sciences, Agroecology and Agricultural Sustainability. From their postgraduate training he has developed research projects in the field of valorization of agricultural waste using biochar and compost and evaluating its effects on soil and agricultural crops. Currently he works as a teacher and researcher in the Department of Agricultural and Aquaculture Sciences of the Catholic University of Temuco.

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Notes/Comments: