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A comparison of chemical, thermal and biological approach to evaluate compost stability

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Text

Introduction

Biological processes such as composting, bio-stabilization, and bio-drying are used in solid waste management in order to convert waste matter into agriculturally useful products, into safe refuse for disposal in landfills and into refuse-derived fuel. Irrespective of the process, all these methods achieve high levels of biological stability by proceeding from an aerobic process to one of degrading degradable organic matter.

Biological stability determines the extent to which readily biodegradable organic matter has decomposed (Lasaridi and Stentiford, 1996). It identifies the actual point reached in the decomposition process and represents a gradation on a recognized scale of values, which thus enable comparison of the process of decomposition (Lasaridi and Stentiford, 1996).

Literatures agree with the fact (Inbar et al., 1990; Barberis and Nappi, 1996; Chen et al., 1996; Itävaara et al., 2002) that no technique or method can be successfully used alone for the evaluation of biological stability. This because one parameter is not able to describe a complex matrix such as compost. On the other hand the integrated use of different parameters, i.e. biological, physical and chemical parameters, surely gives a more complete picture of what compost is (Mondini et al., 2003).

The aim of this work was the characterization of the degree of decomposition of the organic matter, i.e. biological stability, of 15 composts by an integrated chemical,

physical and biological approach.

Core

Fifteen composts of different origin were submitted, in three labs (A, B and C), to a series of chemical, biological and physical analysis in order to evaluate the degree of evolution of the organic matter of composts (biological stability):

Lab. A, followed a chemical approach by determining the humification parameters (HI, DH, HR and NH) after the extraction of humified fractions from composts by using 0.1 NaOH + 0.1Mol L^{-1} $Na_4P_2O_7$ and chromatographic fractionation of no-humified fractions (NH) (Sequi et al., 1986; Ciavatta et al., 1990).

Lab. B, followed a biological approach, i.e. a respirometric analysis. This analysis allows describing the decomposition degree of the organic matter of compost by measuring the oxygen uptake rate (mg O_2 kg^{-1} OM h^{-1}), determined under standardized conditions (DRI) (Adani et al., 2004).

Lab. C used a physical approach consisting in the determination of thermal characteristics of compost. In this case the use of thermogravimetry and DSC analyses estimated thermal characteristics of composts directly related to OM composition (Dell'Abate et al., 1998, 2000).

All analyses were performed in triplicate. Results were subjected to statistical analysis by ANOVA; sample means were compared by Student-Neumann-Keuls test (Snedecor and Cochran, 1980). A multivariate analysis with the use of Pearson coefficients was used to determined possible correlation between results (SPSS statistical package version 11.5).

Humification parameters (HI, DH, HR) were not able to describe the degree of the OM decomposition because of limits in analytical resolution. Nevertheless, no-humified materials (NH), represented by organic molecules such as proteins and sugars (Lowe, 1975) well correlated with both DRI and labile OM fraction determined by thermo analysis (0.79 $p<0.01$ and 0.63 $p<0.05$, respectively). As both DRI and labile fraction are function of the content of easily degradable OM, results obtained do not surprise.

Nevertheless, the fact that three completely different approaches gave similar results indicates that all methods suggested are able to measure the OM decomposition rate.

Conclusion

In conclusion, no-humified fraction (NH) determined by chemical approach and the more labile organic fraction determined by thermal analysis, are able to describe the biological stability of the organic matter simulating biological processes assessed by

respirometric analysis.

Further trials will be performed in order to enlarge the statistical base of knowledge, to verify the observed relationships on a larger scale of samples and possibly to develop an new index for compost stability, more sensitive respect the past and valuable through an integrated chemical, biological and thermal approach.

References

Adani F., Confalonieri R., Tambone, F. (2004). Dynamic respiration index as descriptor of the biological stability of organic wastes, Journal Environmental Quality, 33, 1866-1876.

Barberis, R., and P. Nappi. 1996. Evaluation of compost stability. P. 175-184. *In:* M. de Bertoldi et al. (ed.) The Science of Composting . Blackie Academic and Professional, Glasgow, Scotland.

Chen, Y., B. Inbar, B. Chefetz , and Y. Hadar. 1996. Compost and recycling of organic wastes. p. 341-362. *In:* D. Rosen et al (ed.) Modern agriculture and environment. Kluwer Academic Publishers, Dordrecht, The Netherlands.

Ciavatta C., M. Govi, L. Vittori Antisari and P. Sequi. 1990. Characterization of humified compounds by extraction and fractionation on solid polyvinilpyrrolidone. J. Chromatogr. 509: 141-146.

Dell'Abate, M.T., A. Benedetti and P. Sequi. 2000. Thermal methods of organic matter maturation monitoring during a composting process. J. Therm. Anal. Calorim. 61: 389-396.

Dell'Abate, M.T., S. Canali, A. Trinchera, A. Benedetti and P. Sequi. 1998. Thermal analysis in the evaluation of compost stability: a comparison with humification parameters. Nutr. Cycling Agroecosyst. 51 : 217 – 224.

Inbar, Y., Y. Chen, Y. Hadar and H.A.J. Hoitink. 1990. New approaches to compost maturity. Biocycle. 31 : 64-69.

Itävaara, M., O. Venelampi, and A. Kapanen. 2002. Compost maturity – problems associated with testing. P. 373-382. *In:* H. Insam et al. (ed.) Microbiology of composting. Springer Verlag, Heidelberg, Germany.

Mondini, C., M.T. Dell'Abate, L. Leita and A. Benedetti. 2003. An integrated chemical, thermal and microbiological approach to compost stability evaluation. J. Environ. Qual. 32: 2379 - 2386.

Lasaridi, K E., and E.D. Stentiford. 1996. Respirometric techniques in the context of

compost stability assessment: principles and practice. p. 567-576. *In* M. de Bertoldiet al. (ed.) The Science of Composting. Part 1. Blakie Academic & Professional, London, UK.

Senesi, N., and G. Brunetti. 1996. Chemical and physico-chemical parameters for quality evaluation of humic substances produced during composting. p. 195-212. *In:* M. de Bertoldi et al. (ed.) The Science of Composting . Blackie Academic and Professional, Glasgow, Scotland.

Sequi P.,M. De Nobili, L. Leita, and G. Cercignani. 1986. A new index of humification. Agrochimica 30: 175 – 179.

Snedecor G., and W.G. Cochran. 1980. Statistical methods. 7^{th} ed. Iowa State Univ. Press, Ames.