CONTROL OF A III-PHASE OLIVE POMACE COMPOSTING PROCESS USING THE CIELab COLORIMETRIC METHOD

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ABSTRACT

Olive oil extraction is one of the most traditional agricultural industries in the Mediterranean countries, like Greece, with an important role in local and international economy. The olive oil extraction process in three-phase olive mills produces, besides olive oil, which is the main product, large quantities of two by-products: a) the solid residue known as olive pomace and b) an effluent known as olive mill wastewater (OMWW). Olive pomace is usually taken to olive pomace industries where pomace oil is extracted using hexane as solvent [1]. After the extraction, the remaining solid residue is used as solid fuel. However, the OMWW, which usually remains unprocessed, is particularly harmful to the environment. A number of studies have shown that it has a negative impact on soil microbial populations and aquatic ecosystems creating a major environmental issue in oil producing countries [2, 3]. Therefore, there is an urgent need to develop processing technologies for olive mill by-products, in order to avoid their unprocessed disposal in the environment. Co-composting is one of the main technologies for olive mill waste treatment, both for solids and fro OMWW [1]. One of the most important difficulties in composting is the rapid and accurate determination of the maturity of the final product [4, 5]. Colorimetry, and more specifically the color variables of the CIELab color model, can provide a solution to this problem through a direct and easy analysis, contrary to conventional complex analytical methods of maturity [6, 7].

The objective of this study, is to control the composting of olive mill solid residues, with the use of the CIELab colorimetric method. Composting was conducted in an industrial scale open windrows system. Aeration of the compost pile was ensured by turning using a tractor. The solid residues in the compost pile contained olive pomace and olive leaves in a ratio of 5:1 respectively. The entire composting process lasted for 80 days. Samples were collected every two days according to the zig-zag method, where 15 sub-samples from different depths and parts of the pile were combined into one sample which represented all physicochemical properties of the composted material [8]. These samples were subjected to a series of chemical analyses in order to record specific composting indices and parameters, including pH, total Kjeldahl nitrogen, ash content and total organic carbon [9]. At the same time, the evolution of CIELab color variables, which can be used to control the composting of biomass, was also recorded using a colorimeter [6].

Color variables a, b, C and ΔE alter via time and they have been measured throughout the composting period. The use of the CIELab model for composting control is enhanced after the 15^{th} and 30^{th} day of the process by the use of two additional color variables, h and a/b. Finally, using linear coefficients, the possible correlation between color variables and physicochemical parameters of composting was checked. Total organic carbon content shows the best linear correlation ($R^2>0.9$), followed in descending order by total Kjeldahl nitrogen content, pH and C/N. The existence of adequate linear correlation between specific CIELab color variables and physicochemical parameters, which are also compost maturity indexes, permits the use of color in composting as a method to determine not only the value of each individual physicochemical parameter but also the stage of maturity. Colorimetry can significantly reduce control costs and time in composting, as color measurement is a direct, easy and inexpensive analysis.

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