RETASTE Conference Abstracts
Vol. 3 RETASTE-COM-421-Oral
Athens, Greece, 27-29 September, 2023

rethink food resources, losses, and waste 2023 retaste

Development of an Innovative Compost Maturity Evaluation Method Using the CIELAB Colour Model

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Abstract

An applied and promising method for treating various biowaste for the production of organic fertilizers and soil amendments is composting (Epstein, 1997). Compost maturity is essential due to the fact that immature and poorly stabilized composts can lead to a series of problems regarding storage, use and marketing (CCQC, 2001). Most of the typical maturity indices require expensive and time-consuming analyses that have also been questioned about their reliability thus making compost maturity evaluation impractical (Thompson, 2001). As a result, in order to reduce operating expenses, composting evaluation is often compromised which results in the production of immature composts that may inhibit seed germination and reduce plant growth. Four Green Waste (GW) industrial scale composting processes, in two experimental cycles with different GW collections periods and added materials, were monitored using CIELAB colour variables in order to correlate them with composting time and critical physicochemical compost variables as a means to evaluate GW compost maturity. Colour variables a*, b*, C* and ΔE* were found to exhibit a constant variation trend until the point of maturity, presenting a strong correlation with composting time (R^2>0.80) during all composting processes. Moreover, in each composting cycle color values and progress were similar regardless of the different added materials that were implemented. However, CIELAB colour variables, and especially the initial values, were found to be dependent of the inherent characteristics of the main composting material. In each composting cycle different fitting equations described colour progress via time in accordance with each general composting progression, as results showed strong correlations (R2 > 0.80) for almost all measured compost variables with several CIELAB colour variables. Colour variable Δb appeared to bypass the influence of the inherent characteristics of the materials, as all composting experiments reached maturity when Δb values were greater than 2.81±0.21. As a conclusion, colour variable Δb can be used to evaluate the maturity of a composting process that utilizes the same main substrate, regardless of variations in composting parameters such as extra added materials, windrow size, initial conditions, properties and collection period. Δb maturity values are not similar for all substrates (Tsivas et al., 2021) (Khan et al., 2009) and cannot be used as a universal maturity index for all composting procedures. Different maturity colour charts using the variable Δb should be developed for each composting substrate. Therefore, two different colour

protocols are presented for the evaluation of compost maturity using a rapid and low-cost analysis that can reduce composting operating costs up to 57.64% and 79.07%, respectively. These novel compost monitoring and evaluation protocols could encourage composting facilities to evaluate compost maturity more accurately without increasing costs in order to produce better organic fertilizers that will ultimately enhance soil remediation and crop yields.

Keywords: CIELAB model, compost colour protocols, compost maturity, Green Waste composting

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