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Food waste humification: a process analysis

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Abstract. Food and Agricultural Organization estimates that roughly 1.3 billion kitchen trash are generated annually on a global scale. By using composting, we could convert our kitchen waste into a properly sanitized, humus-rich, relatively stable product that improves plant growth by conditioning soil. Introduction. The main objective of this study is to conduct a review of fundamental of composting, humus, and enhanced humification. Humus is created from degraded organic compound by the polymerization and condensation of organic components such polyphenols, reducing sugars, and amino acids. Humification can be increased through vermicomposting, the addition of biochar made from digestate, the addition of microbes to food waste compost, the addition of cow manure, multistage inoculation, solid state anaerobic digestion (SSAD), and composting hybrid processes.

1. Introduction

Food waste includes food that hasn't been eaten and food that has been prepared in places like restaurants, schools, and factories [1]. There will be less work and expense involved in transporting food if there is less loss and waste of food at home. Composting is an effective method for managing food waste because it produces fewer harmful byproducts and a more valuable end product than other disposal methods [2]. By using composting, we could convert our kitchen waste into a properly sanitized, humus-rich, relatively stable product that improves plant growth by conditioning soil [3]. Food waste composting is acceptable if it results in nontoxic compost (germination index value > 80%, thermophilic time > 10 days), high humification (humus content > 25%, E4/E6 ratio 4) and stable physicochemical qualities (pH value > 7, moisture content 5%) [4]. The main objective of this study is to conduct a mini review of fundamental of composting, humus, and enhanced humification.

2. Compost and humus

Compost is a type of natural fertilizer comprised of decayed organic matter. The end product of composting is a collection of partially decomposed organic materials known as humus [5]. Composting results in the production of humic compounds and a rise in the amount of humic acid-like organic-C, but it results in a decrease in the amount of fulvic acid (FA)-like organic-C and water-extractable organic-C due to microbial degradation [6]. Humification is the process of decomposing organic matter into humic compounds, which are mature organic matter [7]. Humin (molecular weight [MW] = 100,000–10,000,000 kDa), humic acids (HAs; MW = 10,000–100,000 kDa), and fulvic acids (FAs; MW = 1000–10,000 kDa) are the three primary fractions that make up the components of humic (Pettit, 2004).



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Humus is created from degraded organic compound by the polymerization and condensation of organic components such polyphenols, reducing sugars, and amino acids. The degree of polymerization (DP), which is a method that may be used to determine the maturity level of compost, is one of the humus indicators. This method is also one of the humus indicators. According to Ko et al. [8], if the compost has a DP value that is larger than 1.6, it has reached its mature state and can be utilized in agriculture and other fields.

3. Enhanced humidification

Cai et al., [9] have utilized vermicomposting to decompose food waste combined with soybean meal and sugarcane bagasse for five weeks. The amount of humic and humic acids went up because there was more sugarcane bagasse (SCB), but the amount of fulvic acid went down because the rate of humification went up. Vermicomposting with the addition of SCB led to an increase in humification [9], due to an increase in the activity of microorganisms responsible for humification [10]. Also, polysaccharides that are made when lignocellulosic materials break down in SCB are thought to be the main sources of H₂S, along with the reduced carboxyl group content that happens during humification.

The humification could be enhanced by adding biochar produced from digestate [11]. The addition of 25% biochar is optimal for encouraging the degradation of organic matter, minimizing NH₃ emissions and increasing the formation of humic-acid-like matter, thereby increasing humification. Evaluation of degradation, emission, and humification was carried out on days 5, 11, 19, 27, 35, 43, and 50. The compost was manually turned over.

The process of adding microbes to compost made from food waste can serve as a bioaugmentation method for the synthesis of humic acid (H₃) [12]. In order to demonstrate how bioaugmentation works, many methods like as statistical analysis, thermogravimetric analysis, structural equation modeling, and Fourier transform infrared spectroscopy (FTIR), among others, can be utilized. Bioaugmentation can hasten the production of humic acid and the decomposition of food waste by increasing the rate at which these processes occur.

According to Xu et al. [13], a multistage inoculation pattern can be used to increase both humification (with a high germination index of 120.9%) and humic substances (with a high humus index of 4.3 and a biological index of 1.4). Strains of *Bacillus subtilis*, *Geobacillus thermoleovorans*, and *Lactobacillus amylophilus* were used in the inoculum. Composting food waste through a solid state anaerobic digestion (SSAD) and composting hybrid process resulted in a rise of 28.4% and 17.6% in the amount of humic acid in the compost on day 15 and day 21, respectively. The rate at which the digestate's HA content grows is sped up dramatically when cow manure is added to the composting process [14].

4. Conclusion

Humification is the process of decomposing organic matter into humic compounds, which are mature organic matter. Humus is created from degraded organic compound by the polymerization and condensation of organic components such polyphenols, reducing sugars, and amino acids. One sign of humus is the degree of polymerization (DP), and a DP value of more than 1.6 means that the compost is mature enough to be used in agriculture. Vermicomposting, adding charcoal produced from digestate, adding microbes to food waste compost, adding cow manure, multistage inoculation, solid state anaerobic digestion (SSAD), and composting hybrid processes are all ways to promote humification. Vermicomposting is also known as worm composting.

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