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Abstract

Bio-Char Production from Algal Biomass †

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Introduction: Bio-char is a form of charcoal produced from biomass by a process known as pyrolysis. Bio-char is also another product from pyrolysis and has carbon content of over 50%. Bio-char has unique properties that make it a valuable soil amendment to sustainably increase soil health and productivity. It can also be used for sequestering atmospheric carbon dioxide in soils [1]. Algal biomass was used in pyrolysis process at 350–450 °C temperature range in a Parr reactor, obtaining bio-oil, bio-char and residual gases. The aim of this study was to valorize bio-char byproduct obtained from algal biomass pyrolysis. The results showed that the pyrolytic bio-char has the characteristics for carbon raw material. These materials have potential after activation to be used in agricultural plant production, as fertilizers and soil conditioners. However, the nutrient contents ofbio-char and performance depend on the source of the feedstock and pyrolysis conditions. The thermogravimetric analysis, N_2adsorption–desorption analysis and elemental analysis were performed to investigate the pyrolytic characteristics and essential components. Materials and methods: The raw material used in this research was *Chlorella* sp. biomass at 80% humidity. Catalytic pyrolysis was performed in a laboratory-scale stationary tubular reactor using a mesoporous catalyst. The chemical components and the physical characteristics of algae and bio-char were investigated by thermogravimetric analysis TGA (TA Instruments), N_2adsorption–desorption analysis (Nova 2200e) and elemental analysis. Results: The thermo-decomposition of organic matter of algae under pyrolysis was investigated by TGA. This technique measures the amount and rate of change in the weight of material as a function of temperature. TGA is used to determine the relationship between the weight loss or gain and the temperature due to decomposition, oxidation or dehydration. The results of the TGA of the pyrolytic characteristics of the algae and bio-char suggested the presence of three common stages. The first stage is dehydration, which occurs at the beginning at 50–200 °C; the second stage is the release of volatile compounds; and the last stage is solid decomposition at a temperature range of 600–900 °C. Conclusions: The chemical composition of bio-char obtained from the pyrolysis of algal biomass included carbon (>60%), nitrogen, hydrogen and nutritive elements (K, Ca, Na, Mg, Si). Bio-char can be used as a natural fertilizer or support material for controlled release of nutritive elements due to positive effects on the environment (reduced eutrophication risk, atmospheric carbon capture and degraded soil amendment) and in agricultural production. Additionally, bio-char has the ability to reduce soil acidity, and it can increase electric conductivity and cationic exchange capacity, as well as ulterior nutrient availability. Increasing soil pH by application of bio-char is a well-documented mechanism for improving nutrient availability, especially N and P.

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