MICROALGAE BASED BIOCHAR APPLICATION IN AGRICULTURE

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ABSTRACT

Green algae are highly versatile microorganisms with diverse applications in agriculture, the food industry, and medicine. In agriculture, they play a crucial role in enhancing plant growth by improving soil fertility. This study investigates the potential of green algae-derived biochar as a soil amendment to promote plant growth. Biochar was produced from raw green algae collected from a college drainage system and analysed for its nitrogen content using Elemental Analysis. The biochar was prepared by pyrolyzing dried, shredded green algae (initial weight: 34.57 g) at 350°C and 400°C for 40 minutes. The algae were divided into four crucibles (8.42 g each), and after combustion, the 350°C biochar yielded 13.26 g, while the 400°C biochar yielded 13.05 g. Biochar at each temperature was mixed in a 1:1 ratio by volume with two different plant-growing mediums: cocopeat, and clay soil. The experiment selected the cultiva, water spinach (Ipomoea aquatica) and choy sum (Brassica sp), and then watered by distillation water. Plant height was measured at 12-days intervals during the growing period. The result showed that raw biochar at 350°C in cocopeat can support water spinach plant growth, with the best plant growth of 14 cm, which is the best condition for plant growth. Instead, algae biochar produced with cultured algae at 60°C had lower plant growth, so it showed poor agricultural potential. Overall, increased plant height and growth in the treated soils indicates that raw green algae biochar especially at the pyrolysis temperature of 350°C, can be a potential amendment for sustainable agriculture.

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CHAPTER ONE
BACKGROUND

1.1 Introduction

Microalgae are microscopic organisms found in both aquatic and terrestrial ecosystems [2]. As a result, they represent many species capable of living in a variety of environments [2]. Microalgae require three main components for growth: sunshine, water, and a carbon source [2]. They collect nutrients from aquatic environments, absorb sunshine, extract CO2 from the air, and create around half of the atmospheric oxygen [2]. Microalgae have a very efficient biological system that uses sunlight to produce organic molecules [2]. Many studies have shown that microalgae can totally remove nitrogen, phosphorus, and harmful components from many types of wastewaters, producing biomass, including municipal, industrial, agro-industrial, and animal wastewaters because certain microalgae species have adapted to thrive in wastewater, integrating wastewater treatment with microalgae production can help to cut manufacturing costs. [5]

Microalgae are known as pollution scavengers capable of bioremediating a wide range of pollutants emitted by many sectors, including industrial, agricultural, and household [6]. In addition to the common inorganic and organic compounds found in wastewater, such as heavy metals, xenobiotics, nitrates, phosphates, and carbon compounds, microalgal cells can absorb and degrade more persistent pollutants, such as antibiotics, polychlorinated biphenyls (PCBs), and hydrocarbons, which can be highly toxic to humans [6]. Wastewater typically contains proteins, carbohydrates, lipids, volatile acids, and inorganic material such as nitrate ions, phosphate ions, sodium, calcium, potassium, magnesium, chlorine, sulfur, bicarbonate, ammonium salts, and heavy metals [1].

Excess nutrients in water bodies can lead to eutrophication and algal blooms from anthropogenic waste generation [1]. Algae buildup is a significant issue, especially near the conclusion of the growth season when most algae die in the aquatic system [1]. In aquatic environment, algae decay reduces dissolved oxygen, resulting in eutrophication, unpleasant smells and death of aquatic organisms [1]. In an algae-based strategy, sufficient micronutrients in the residential sewage like nitrogen, phosphorus, and carbonaceous compounds are absorbed to support algae growth, consequently reducing their concentration in the water in a very monitored and steady manner, has been commonly used in wastewater treatment [3]. The main advantage of using microalgae is high growing rate as well as high adjustment in wastewater