The Effect of Expired-Milk-Derived Biochar Amendments on Enhancing Cowpea (Vigna unguiculata) Growth

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Expired milk products pose significant challenges for the dairy industry, with millions of tons of waste generated annually worldwide that must be disposed. Current disposal methods, such as landfilling or direct soil application, are inadequate and can lead to greenhouse gas emissions, soil and water pollution, and loss of valuable nutrients. This study investigated the potential of recycling expired milk into biochar as a sustainable soil amendment to enhance plant growth while addressing the waste management problem. Expired milk products were collected, and the protein compounds were extracted, dried, and ground into a powder.Three types of biochar were prepared by pyrolyzing milk powder mixed in a 50:50 ratio with either crushed palm leaves, cow manure, or ophiolite soil at 400°C.The physical and chemical properties of the biochar were characterized using SEM/EDS, FTIR, and XRF analyses. The effects of the milk-derived biochars on the growth of cowpea (Vigna unguiculata) were tested in a pot experiment with different soil amendment treatments.Results showed that while direct soil application of milk powder negatively impacted plant growth, the milk-derived biochars were safe and enhanced some growth parameters.The biochar derived from expired milk mixed with ophiolite soil was the most effective, followed by biochar from milk mixed with palm leaves and then cow manure. SEM/EDS, FTIR and XRF analyses revealed the biochar contained beneficial elements and functional groups that could improve soil properties and plant nutrition.This study demonstrates that converting expired milk into biochar is a promising strategy to recycle dairy waste into a sustainable soil amendment that can promote plant growth while mitigating the environmental impacts of waste milk disposal.

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