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Unearthing Approaches to Harness the Potential of Hop Waste Biomass

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Abstract

During the hop harvesting process, the complete aboveground biomass is systematically extracted from the agricultural fields, leaving behind residual stems and leaves as a by-product, which is subsequently collected adjacent to the harvesting facilities. This surplus hop biomass can attain quantities of up to 18 metric tonnes per hectare, with an average of approximately 15 metric tonnes. Regrettably, this residual material is frequently categorized as waste, notwithstanding its significant potential as a versatile raw material with diverse applications. The potential applications for waste hop biomass encompass an array of environmentally responsible practices, including bio-gas production, composting, biomass utilization for heat generation, extraction of antioxidants for incorporation into food and pharmaceutical products, as well as fiber production for utilization as an additive in the manufacturing of biodegradable biocomposites, providing a sustainable alternative to conventional plastic materials. In this context, the principles of a circular economy can be strategically harnessed, with the judicious utilization of hop waste biomass as a valuable resource for composting standing out as a particularly prudent approach. Of note, the waste hop biomass generated from a single hectare of hop plantation is a substantial source of essential nutrients, including 21–22 kg of phosphorus pentoxide (P_2O_5), 50–71 kg of potash (K_2O), 32–41 kilograms of magnesium oxide (MgO), 5.5 kg of sulphur (S), and 88–99 kilograms of nitrogen (N). So, on-farm composting represents an efficient, cost-effective, and ecologically sound biological process for recycling residual biomass. By reintroducing this material into the soil in the form of high-quality organic fertilizer, agricultural practitioners can augment both the nutrient content and organic composition of the soil. This, in turn, leads to the cultivation of more resilient and sustainable agricultural practices. The adoption of circular economy principles, in this context, is instrumental in fostering the long-term sustainability of the hop industry, simultaneously fostering environmentally responsible and socially equitable agricultural production methods. Furthermore, noteworthy milestones were achieved by developing two distinct processes for extracting fibers from waste hop stems, each serving a specific purpose. These extracted fibers can first be incorporated into the production of biodegradable and compostable wine bottle transport packaging, offering an environmentally sustainable alternative to conventional packaging materials. Additionally, the extracted fibers can be effectively employed as a key

component in the production of biocomposites, facilitating the creation of various biodegradable and compostable products. In total, LIFE project BioTHOP has successfully devised 13 such products. Upon the completion of their useful lifecycle, these products can be subjected to composting, where they degrade into water, carbon dioxide, and organic matter. The resultant compost can then be judiciously applied to reintroduce valuable nutrients and organic matter to agricultural land, thus fostering a closed-loop, sustainable agricultural system.

Keywords: green waste, hop plant waste biomass, composting, biodegradable products, reuse, biodegradable biocomposites, biodegradable products

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