AnisGuard: A Multifunctional Biofungicide of Fennel Seeds for Controlling Penicillium spp. in Postharvest Coffee-Beans

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The AnisGuard project was born from the urgent need to combat the contamination crisis caused by filamentous fungi in coffee beans from Brazil, a threat that compromises food safety through secretion of Ochratoxin A in coffee beans, generating economic losses for 10% of Brazil's national coffee output. Therefore, this study aimed to develop an efficient, natural, sustainable, and economically viable antifungal alternative. In direct bioassays with Arabica coffee beans, three extract concentrations were tested (5%, 10%, and 15%), with experiments performed in the actual farm storage environment.The 15% formulation showed the best performance, reducing fungal load from approximately 6.8 × 10^4 to only 1.1 × 10^4 CFU/g, corresponding to 83.8% inhibition compared to the control, and outperforming the synthetic fungicide reference. Moreover, treated beans maintained nearly stable mass, indicating lower physical deterioration. The economic impact was also significant: the treatment cost per kilogram of coffee ranged between US$0.016 and US$0.024, making AnisGuard up to 4.3 times more affordable than conventional fungicides. In parallel, post-extraction seed residues were reused as biofertilizer, promoting within just five days an increase in soil pH (from 5.4 to 6.2) and enrichment in organic matter, phosphorus, and potassium. Beyond its local application, AnisGuard offers a global solution: fungal contamination affects coffee worldwide, threatening food safety and farmer livelihoods in Latin America, Africa, and Asia. By combining efficacy, affordability, and sustainability, AnisGuard directly advances the United Nations Sustainable Development Goals and provides practical benefits for smallholder farmers across the globe.

Awards Won:
Fourth Award of $600