An Efficient Simple Point-of-Use Water Purification Filter System From Oryza sativa Impregnated With Nanoparticles for Poor Household and Semi-Arid Areas in Kenya

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Kenya faces substantial challenges regarding water scarcity, sanitation, and hygiene, significantly impacting public health, economic growth and social equity. With a significant portion of the population lacking access to safe drinking water and basic sanitation facilities, reliance on contaminated water sources remains prevalent, posing severe health risks. This study addresses these challenges by investigating the use of rice by-products, specifically silica nanoparticles from rice husk ash and activated carbon from rice straw, to develop an efficient point-of-use water purification system. Silica nanoparticles were synthesized from rice husk ash, characterized by XRD, FTIR, and SEM analyses, demonstrating their amorphous nature, functional groups, and porous structure, with a crystalline size of 50nm. The extraction process of activated carbon involved multiple steps including lignin removal, holo-cellulose and α-cellulose isolation, and pyrolysis at 800°C, resulting activated carbon suitable for filtration applications. The developed point-of-use water filter incorporates a rubber gasket, wire mesh, activated carbon layer infused with nanoparticles, and a mesh net to ensure optimal flow rate. Annual maintenance is recommended to preserve pore integrity and bacterial trapping efficacy. Tests conducted with the developed activated carbon and silica nanoparticles exhibited an impressive efficiency of 93.33%, highlighting the systems capability to purify water effectively for safe consumption. This research contributes to addressing water quality issues in resource-constrained settings by leveraging sustainable agriculture by-products for water purification.