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Surface modification of *Leucaena leucocephala* wood biochar using coconut vinegar

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Over the last few decades biochar has emerged as a popular low cost adsorbent for water treatment due to its abundance and cost-effectiveness. Number of studies have reported the efficiency of strong acids such as nitric, sulfuric, hydrogen peroxide, etc. in activating biochar. However, as these chemicals are expensive, corrosive and difficult to be handled by unskilled personnel, use of these chemicals is limited to industrial activation processes. To provide a user friendly economical activation process, this study focused to evaluate the ability of natural coconut vinegar, in activating *Leucaena leucocephala* wood biochar. Coconut vinegar, a common food additive, is a 4 % acetic acid solution in water (4 g acetic acid/ 100 mL vinegar, pH 2.5). *Leucaena leucocephala* is a common, fast-growing tree with light wood and soft foliage. It is widely used for fuelwood. In this study, air dried *Leucaena leucocephala* wood pieces were allowed to burn in a domestic kiln (300 ºC, 2 hours) to produce biochar. The activation of biochar was done by soaking it in coconut vinegar for 24 hours followed by oven drying (120 ºC, 3 hours). After cooling it was washed with de-ionized water and further dried in oven at 80 ºC overnight. Fourier transform infrared spectra exhibited hydration of the C-O-C bridges of the biochar surface introducing new -OH groups and the possible introduction of carbonyl/ester/carboxylic functional groups to the biochar surface after the vinegar treatment. Recently, a positive correlation has been cited among the number of Chronic Kidney Disease of Unknown Etiology patients and the levels of ground-water hardness, in Sri Lanka. Hence, the efficiency of coconut vinegar activated *Leucaena leucocephala* biochar in reducing calcium ions from potable water was tested. Adsorption and desorption studies carried out using column tests showed a 1.7 fold increase of calcium ion adsorption capacity and a 7 fold increase of calcium ion retaining capacity after the vinegar treatment, with compared to the non-activated biochar. Calcium content in solutions was measured using flame photometry. Calcium adsorption capacities of non-activated biochar and activated biochar determined by column tests ranged from 3.10-3.82 mg/g and 5.27-6.68 mg/g respectively while calcium retaining capacities ranged from 0.16-0.22 mg/g and 1.28-1.4 mg/g respectively. Batch studies matched with both Langmuir (R^2 = 0.9761) and Freundlich (R^2 = 0.9785) isotherm models. Maximum adsorption, q_m was calculated as 23.8 mg/g using Langmuir equation. This study concludes that *Leucaena leucocephala* biochar can be activated using coconut vinegar to be used as a safe and cost-effective adsorbent for calcium ion removal from potable water.

Keywords: Coconut vinegar, Biochar, *Leucaena leucocephala*, Calcium, Adsorption capacity

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