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Characterization of activated charcoal produced from palmyrah (*Borassus flabellifer)* seed shell for the formulation of handwash

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Abstract

The ability of activated charcoal to cleanse and absorb impurities from the skin is well known. However, the high cost and non-renewable nature of commercially available activated charcoal have hindered its widespread use in large-scale industrial settings. In Sri Lanka, the hard and lignified shells of palmyrah seeds are currently underutilized despite their potential for producing activated charcoal.The aim of this study was to characterize the activated charcoal derived from the shell of palmyrah seeds (*Borassus flabellifer*) for use in handwash formulations. Initially, the dried seed shells underwent carbonization using the traditional barrel method for a duration of 1.5 hours. The resulting material was then subjected to both chemical activation using a mixture of lemon juice, potassium hydroxide (KOH), and calcium chloride (CaCl2) at a 25% concentration in a 1:2 impregnation ratio, and physical activation through thermal treatment at temperatures of 600 ˚C and 800 ˚C for 45 minutes. Measurements of physiochemical, proximate, and Fourier Transform Infrared Spectroscopy of produced activated charcoal were conducted using commercial activated charcoal as a reference. The best-activated charcoal was selected based on the comparison, for the formulation of handwash at the rate of 0.5 % and 1 %. The foamability, pH, density, antimicrobial activity, and sensory analysis of formulated handwash were compared with a commercial handwash. It was found that chemical activation provided a higher yield compared to physical activation. The physicochemical, proximate, and surface chemical properties of the activated charcoal were significantly influenced (p value < 0.05) by the methods of activation, which included acid, base, neutral, and thermal methods. Additionally, the activation temperature had a significant effect (p value < 0.05) on these properties, except for the moisture content. Surface chemistry analysis of produced activated charcoal revealed the presence of hydroxyl, carbonyl, carboxyl, alkyne, and aromatic groups, which were similar to that of commercial activated charcoal. Among all the produced activated charcoal, treatment with KOH 800 ˚C was selected for the formulation of handwash due to its high percentage similarity to commercial activated charcoal properties. Formulated handwash showed similar density, formability (*p value* > 0.05), and antimicrobial activity of commercial handwash except pH. Aesthetic attraction to color on the sensory analysis resulted in selecting formula 1, which contained 0.5 % activated charcoal, as the best formulation. It can be concluded that palmyrah (*Borassus flabellifer*) seed shell activated charcoal can be successfully used to produce commercial-scale handwash.

Keywords: Activated charcoal, Characterization, Handwash, Palmyrah seed shell

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Acknowledgement: This work was done with the contribution of Uva Wellassa University of Sri Lanka and Palmyrah Research Institute, Sri Lanka