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An integrated sequential production of bio-ethanol, biodiesel and briquette from spent coffee ground

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In this study, biodiesel, bioethanol and briquette samples were sequentially produced from spent coffee ground. The oil extracted from spent coffee ground with solvent extraction route at hexane to spent coffee ground ratio of 22.5 g/g with an extraction time of 30.4 min resulting in 11.892% of oil yield. This was comparable with literature values and subsequently used for biodiesel production experiments using a 1% by wt of NaOH at reaction temperatures and residence times ranging from 50 to 65°C and 20 to 60 min, respectively. The optimization carried out using central composite design methodology gave 81.507% of methyl-ester yield at a reaction temperature of 57.133°C and reaction time (residence time) of 45.117 min with model determination coefficient (R^2) of 0.9465 while the optimum reducing sugar yield for dilute acid hydrolysis experiments for ranges of operating parameters of temperature (70-100°C) and (1-3 M) of H_2SO_4 concentrations was found to be 39.161% at a temperature of 98.313°C and H_2SO_4 acid concentration of 2.962 M. Experiments were conducted at the predicted optimum conditions and resulted 79.65% of biodiesel yield (out of 11.892 g of oil) and reducing sugars yield of 37.28% (out of the hydrolysate). The bio ethanol produced by simple distillation having alcohol by volume yield of 55% can be considered as a good result and it can be easily concentrated to a fuel grade ethanol by using fractionating column. Moreover, the characteristics of the biodiesel produced were in good agreement with ASTM and EN standards. The end product of the process; briquette has been produced from 75% wt of dilute acid hydrolysis residue and 25% wt of glycerol, resulted a calorific value of 13.35 MJ/kg, with its easy mold -ability. This study signifies the value addition that can be affected from spent coffee ground and results obtained in this regard are discussed.

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