



## Prospect of castor oil biodiesel in Bangladesh: Process development and optimization study

Anjan Deb<sup>a</sup>, Jannatul Ferdous<sup>b</sup>, Kaniz Ferdous<sup>c</sup>, M. Rakib Uddin<sup>b</sup>, Maksudur R. Khan<sup>c</sup>, and Md. Wasikur Rahman<sup>a</sup>

<sup>a</sup>Department of Chemical Engineering, Jessore University of Science & Technology, Jessore, Bangladesh; <sup>b</sup>Department of Chemical Engineering and Polymer Science, Shahjalal University of Science & Technology, Sylhet, Bangladesh; <sup>c</sup>Faculty of Chemical and Natural Resources Engineering, University Malaysia Pahang, Kuantan, Pahang, Malaysia

### ABSTRACT

In this study, castor oil (CO) has been investigated as a potential source for biodiesel production in Bangladesh. Castor oil has been extracted from the seeds by mechanical press and the Soxhlet extraction method. Maximum oil content of 55.7% has been found by the Soxhlet extraction method. The physicochemical properties such as free fatty acid (FFA) content, kinematic viscosity, saponification value, and density of the oil have been measured by different standard methods. The FFA content and viscosity have been found considerably higher such as 33.5% and 253 mm<sup>2</sup>/s, respectively. Biodiesel has been prepared using a three-step method comprising of saponification of oil followed by acidification of the soap and esterification of FFA. The overall yield of FFA from CO is found to be around 89.2%. The final step is esterification that produces fatty acid methyl ester (FAME) and a maximum 97.4% conversion of FFA to biodiesel has been observed. The effect of the oil to methanol molar ratio, catalyst concentration, reaction temperature, and time has been investigated for esterification reaction and optimized using the response surface methodology. <sup>1</sup>H NMR of crude castor oil and castor oil methyl ester (COME) was studied and analyzed that confirms the complete conversion of castor oil to biodiesel. Finally, the biodiesel, produced under optimum conditions, was characterized using the various standard method and found comparable with petro-diesel and biodiesel standard.

### KEYWORDS

Biodiesel; castor oil; esterification; RSM; three-step method