PREFACE

Imminent energy crisis and environmental challenges raised by the extensive use of non renewable energy resources lead serious attention for exploring alternative sources for continuous energy supply in future. In this consequences, energy derived from biomass in form of liquid biofuels i.e. biodiesel, bioethanol, biomethanol etc. have potential to substitute the fossil derived fuels from transportation need along with socio-economic development of rural countries and reduction of carbon dioxide emission benefits. In last two decades, biodiesel is implemented as alternative of petro diesel in CI engines. Biodiesel is constituted by long chain alkyl esters of fatty acid derived from vegetable oil and animal fats. Nowadays, researchers have focused on biodiesel to improve performance, combustion and emission behavior. Biodiesel is economically produced by catalytic transesterification process which requires three basic components: alcohol, lipid feedstock and catalyst. Methanol is usually used as alcohol as it is cheaper and more available than other counters of alcohol family. Edible oils, non edible oils, waste cooking, etc. are used as prominent source of lipid feedstock for biodiesel production. As non edible oils and waste cooking oils are non food materials, thus, their utilization in biodiesel production is more favored. In transesterification reaction, both homogeneous and heterogeneous catalysts are used but heterogeneous catalysts are more advantageous over homogeneous catalysts. Though, heterogeneous catalysts are potential and sustainable, but still there is problem of saphonification in case of high free fatty acid contained feedstock, active leaching issue, poor recyclability, long reaction time, etc. These issues should be resolved to make the biodiesel production, economically feasible and environmentally clean. In present study, K and Ba based solid base catalysts were synthesized and employed in transesterification of waste cooking oil and castor oil. In catalyst synthesis, rare earth metal oxide like ceria oxide, and group 14 metal oxides like tin

oxide were incorporated as support material considering their good thermal and oxidation stability, and leaching protection ability. On the other hand, K and Ba have the highest basic strength in their corresponding groups, so, it was expected that the catalysts derived by K and Ba would be highly active for base catalyzed transesterification reaction. Several physicochemical characterization of synthesized catalysts were executed through TGA-DTA, XRD, XPS, SEM-EDAX, BET-BJH and Hammett base indication –titration method for basic strength determination. In present study, waste cooking oil and castor oil were selected as potential feedstock as their greater abundant and low cost, and also India's current biofuel policy support this fact. The transesterification process was optimized through analyzing the impact of various process variables such as oil to methanol ratio, catalyst weight %, reaction temperature and time. The reusability of the catalysts was investigated to ensure about the endurance capability for biodiesel production. Kinetic and thermodynamic studies were carrying out to find order of the reaction and the nature of the reaction pathway. The greenness approach of reaction and catalyst sustainability were ascertained by E-factor, TOF, and PMI. Later, the product biodiesel was characterized by ^{1}H NMR, ^{13}C NMR and GC-MS. Physicochemical properties of prepared methyl esters were checked thoroughly to ascertain their compatibility with conventional fuel. In comprehensive study, Ba-SnO_2 (or $BaSnO_3$) catalyst in the synthesized catalysts, showed the best performance in very short time following cleaner, greener and faster reaction route.