PREFACE

Scarcity of conventional energy resources has prompted the entire research fraternity to explore renewable energy resources at mass scale. There are several non-exhaustible and renewable resources such as hydel energy, solar energy, hydrogen energy, and biomass derived energy which are continuously leveraged as energy supplements to meet the energy requirement. Among all existing renewable resources, biomass derived energy has come up as a potential energy supplement throughout the globe. Nonetheless, biodiesel has been found as a prominent renewable energy resource. Biodiesel is a very good substitute of diesel fuel. It is safer, less toxic, carbon neutral and less emissive chemical compound. Biodiesel is chemically defined as fatty acid alkyl esters derived from plants or animal fats. Biodiesel is economically produced by transesterification reaction catalyzed by either homogeneous or heterogeneous acids or bases. Though, heterogeneous base catalyst is a potential and sustainable catalyst for biodiesel production, but still there is problem of saponification in case of feedstock with high free fatty acids (FFA) content. This issue can be resolved by application of two step biodiesel production i.e. esterification followed by transesterification. Inceptively, acid catalysts might convert FFA to methyl ester via esterification process. In present study, Ba and Sr based heterogeneous base catalysts were employed in transesterification reaction. Further, rare earth metals and transition metals are known for their catalytic activity owing to thermal stability and excellent oxidation activity ameliorating the catalytic potency of base catalyst due to its variable valences. Regarding aforementioned characteristics of dopants, active Ba and Sr metals were doped with La, Ce, and Ti metals to form highly stable and basic mixed metal oxides as heterogeneous base catalyst for transesterification reaction. Several characterizations of

synthesized solid base catalyst were executed through thermal analysis (TGA/DTA/DTG), PXRD, XPS, SEM-EDX, FT-IR, and BET surface area analysis along with basic strength to analyze physicochemical properties. In present study, non-edible feedstocks have been selected as they don't compete with food security. *Madhuca longifolia* oil, *Millettia pinnata* oil, *Schleichera oleosa* oil, and waste cooking oil were employed as non edible feedstocks for biodiesel production using doped Ba and Sr mixed metal oxides. The process was optimized through analyzing the impact of various process variables such as catalyst dose, oil to methanol molar ratio, reaction temperature, reaction time, and stirring speed along with endurance capacity of catalyst. Additionally, kinetics and thermodynamics of transesterification were also carried out to comprehend the reaction rate and mechanism involved in transesterification reaction. The greenness approach of reaction and catalyst sustainability were ascertained by E-factor and TOF study. Later, the prepared methyl esters were characterized by GC-MS, ^{1}H-NMR, ^{13}C-NMR, and ATR FT-IR spectroscopy. Ultimately, physicochemical properties of prepared methyl esters were checked thoroughly to ensure their compatibility with conventional fuel. Moreover, among all the prepared catalyst samples, the last Sr-Ti mixed metal oxide was found to be the most efficient heterogeneous base catalyst attributing to its high basic strength and surface area. It provided the new path to reaction with lowest activation energy and catalysed the reaction at faster rate relative to others for methyl ester conversion.