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Physical, Chemical and Mechanical Properties of Different Varieties of Jatropha curcas Cultivated in Pakistan

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Abstract : Petroleum crude oil reserves are going to deplete in future due to the consumption of fossil fuels in transportation and energy generating sector. Thus, increasing the fossil fuel prices and also causing environmental degradation issues such as climate change and global warming due to air pollution. Therefore, to tackle these issues the environmentally friendly fuels are the potential substitute with lower emissions of toxic gases. A non-edible vegetable oilseed crop, Jatropha curcas, from different origins such as Malaysia, Thailand and India were cultivated in Pakistan. The harvested seeds physical, chemical and mechanical properties were measured, having an influence on the post-harvesting machines design parameters for dehulling, storing bins, drying, oil extraction from seeds with a screw expeller and in-situ transesterification reaction to produce biodiesel fuel. The seed variety from Thailand was found better in comparison of its properties with other varieties from Malaysia and India. The seed yield from these three varieties i.e. Malaysia, Thailand and India were 829, 943 and 735 kg/ acre/ year respectively. While the oil extraction yield from Thailand variety seed was found higher (i.e. 32.61 % by wt.) as compared to other two varieties from Malaysia and India were 27.96 and 24.96 % by wt respectively. The physical properties investigated showed the geometric mean diameter of seeds from three varieties Malaysia, Thailand and India were 11.350, 10.505 and 11.324 mm, while the sphericity of seeds were found 0.656, 0.664 and 0.655. The bulk densities of the powdered seeds from three varieties Malaysia, Thailand and India, were found as 0.9697, 0.9932 and 0.9601 g/cm^3 and % passing was obtained with sieve test were 78.7, 87.1 and 79.3 respectively. The densities of the extracted oil from three varieties Malaysia, Thailand and India were found 0.902, 0.898 and 0.902 g/ mL with corresponding kinematic viscosities 54.50, 49.18 and 48.16 mm2/sec respectively. The higher heating values (HHV) of extracted oil from Malaysia, Thailand and India seed varieties were measured as 40.29, 36.41 and 34.27 MJ/ kg, while the HHV of de-oiled cake from these varieties were 21.23, 20.78 and 17.31 MJ/kg respectively. The de-oiled cake can be used as compost with nutrients and carbon content to enhance soil fertility to grow future Jatropha curcas oil seed crops and also can be used as a fuel for heating and cooking purpose. Moreover, the mechanical parameter micro Vickers hardness of Malaysia seed was found lowest 16.30 HV measured with seed in a horizontal position to the loading in comparison to other two varieties as 25.2 and 18.7 HV from Thailand and India respectively. The fatty acid composition of three varieties of seed oil showed the presence of C8-C22, required to produce good quality biodiesel fuel. In terms of physicochemical properties of seeds and its extracted oil, the variety from Thailand was found better as compared to the other two varieties.

Keywords : biodiesel, Jatropha curcas, mechanical property, physico-chemical properties
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