Abstract

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Liquid biofuels have emerged as a worldwide alternative fuel with potential to replace fossil fuels. Due to their wide availability as derivatives of organic materials from plants, they have attracted much attention and investment in developing countries including Tanzania, as alternative sources of energy. This study examined effects of oil quality from stem barks and phylloclades of Euphorbia tirucalli trees of different girth sizes (viz., 20 cm, 30 cm, 40 cm, 50 cm, 60 cm, 70 cm, and 80 cm) from semi-arid, coastal, and southern highlands in Dodoma, Dar es Salaam, and Mbeya Southern highland, agro-ecological zones in Tanzania. Using Soxhlet extraction method, oils were extracted from E. tirucalli stem barks with different girth sizes while oils from phylloclades were extracted from matured apical phylloclades collected from shoots of E. tirucalli trees from which the stem bark samples had been collected. Oil yields were determined by measuring the weight of oil (g) by the total weight of sample extracts used (20 g), and the average oil yield on each sample was determined. Oil quality was evaluated as oxidative stability index (OSI), acid values (AVs), and percent free fatty acids (%FFAs). Their results were then compared with the European Union (EU) oil quality standard specifications prescribed in EN 14214 of 6 h, 0.5 mg KOH/g, max and 0.020 maximum wt% limits, respectively. Differences in the quality of E. tirucalli (stem bark and phylloclades) oil were analyzed statistically with paired-sample t test (two-tailed) using the SPSS 15.0 software package. Results showed that the difference in OSIs from stem barks were not significantly higher (3–5 h) than phylloclades (3–4 h) at the $p > 0.5$ level. Also, the difference in AVs and %FFAs from the stem barks (7.6–7.4 mg KOH and 3.8–3.6%) was not significantly lower than those from the phylloclades (8.4–8.1 mg KOH and 4.3–4.0%) respectively. The quality of oil from stem bark and phylloclades samples at different stem girth sizes semi-arid agro-ecological zone was not significantly higher than from southern highland and coastal agro-ecological zones, respectively. Thus, there were no significant differences in the quality of E. tirucalli oil (stem bark and phylloclades) among stem girth sizes in different agro-ecological zones. The AVs and %FFAs of oils from stem bark and phylloclades were higher than the recommended standards, while the OSIs were below the biofuel standard limit. High AVs and %FFAs reduced oil quality by producing considerably low OSIs values than recommended standards. Finally, the study concluded that E. tirucalli oil requires purification to reduce levels of AV and %FFA contents so that the oil becomes suitable for application as liquid biofuel for energy generations.