Research Application Summary

Optimization of biodiesel production from *Jatropha curcas* in Kenya

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Abstract

The non-edible vegetable oil from *Jatropha curcas* has been found to be a viable source for producing biodiesel. Biodiesel production from different accessions of *Jatropha curcas* will be compared in order to determine the highest yielding accession. The analysis of different oil properties, fuel properties and process parameter optimization will be investigated in detail. Transesterification process will be used to produce biodiesel from straight jatropha oil. The fuel properties of biodiesel produced will be compared with ASTM standards for biodiesel. The highest yielding accession will be propagated on a commercial scale of uniform quality, true-to-type, disease-free plants.

Key words: Biodiesel, *Jatropha curcas,* jatropha oil

Résumé

L'huile végétale non comestible de *Jatropha curcas* a s'est retrouvé être une source viable de production de biodiesel. La production de biodiesel à partir de différentes accessions de *Jatropha curcas* sera comparée afin de déterminer le plus haut rendement d'adhésion. L'analyse des propriétés de l'huile, des propriétés du carburant et l'optimisation des paramètres du procédé sera étudiée en détail. Le procédé de transestérification sera utilisé pour produire du biodiesel à partir d'huile de jatropha droite. Les propriétés du carburant de biodiesel produit seront comparées aux normes ASTM pour le biodiesel. La plus forte adhésion du rendement sera propagée à l'échelle commerciale de qualité uniforme, fidèles à la nature et des plantes indemnes de maladies.

Mots clés: Biodiesel, *Jatropha curcas*, l'huile de jatropha

Background

In Africa, *Jatropha curcas* (jatropha) is considered to be one of the most viable candidates for biodiesel feedstocks mostly due to its adaptability to semi-arid lands. Biodiesel promoters regard this "low productive land" (or often called "marginal" or "waste" land) to be largely available for new agricultural development. After having been introduced to Africa centuries ago, it is now widely observed in semi-arid lands throughout the drier area of continent.

In Kenya, it is naturalized in bush lands and along rivers in the western, central and coastal parts of the country in altitudes of 0-1,650 meters above sea level (Maundu and Tengnäs, 2005). Planting of jatropha has been taking place in some locales across Africa. For example, around the N'gurumani area of Kajiado District in Kenya, the local population has extensively planted jatropha as a hedge and boundary marker. In Tanzania, Uganda and Madagascar, jatropha is intercropped with vanilla (*Vanilla planifolia*) to serve as a pole for vanilla vines and to provide shade for vanilla leaves. In these and other African countries, the extracted oil from jatropha seeds has been used for soap making.

In the 1990s, GTZ (German Technical Cooperation) conducted experiments in Mali on the use of jatropha oil as a renewable fuel for powering diesel engines (Henning, 2002). However, it is only recently that the production of jatropha as a biodiesel feedstock has been widely promoted by private enterprises, non-governmental organizations and overseas development assistance agencies working in Africa, including Kenya. Jatropha production has been promoted for its perceived economic and ecological advantages. From the perspective of private investors, it is a newly available energy crop that is expected to be less expensive to produce than other energy crops such as rapeseed and soybeans. This argument is based on the availability of low-cost labour and land in Africa. Like other energy crops, jatropha's contribution to mitigation of greenhouse gas (GHG) emissions is strongly emphasized, with the assumption that new regulations and carbon offset markets will provide price premiums for renewable sources of energy. The Clean Development Mechanism (CDM) of the Kyoto Protocol is expected to promote investment in renewable energy supplies by Annex I developed countries in non-Annex I developing countries with potential to produce biofuel feedstocks. If the acquisition of Certified Emission Reductions (CERs) is assured, the CDM would give additional investment incentives for investors in developed countries who otherwise would not invest in biofuel projects due to the high risk of return.

Not only private enterprises, but also non-governmental organizations and development agencies are interested in supporting jatropha development in Africa as a means for rural development and poverty alleviation. Jatropha biodiesel production is expected to contribute to the improvement of rural livelihood because the main production location for jatropha is in semi-arid lands where poverty levels are high and land productivity low.

Literature Summary

Biodiesel as an alternative fuel for diesel engines is becoming increasingly important due to diminishing petroleum reserves and the environmental consequences of exhaust gases from petroleum-fuelled engines. The availability and sustainability of sufficient supplies of less expensive feedstock will be a crucial determinant delivering a competitive biodiesel to the commercials filling stations. Fortunately, inedible vegetable oils, mostly produced by seed-bearing trees and shrubs can provide an alternative. With no competing food uses, this characteristic turns attention to Jatropha curcas, which grows in tropical and subtropical climates across the developing world (Openshaw, 2000).

Case studies clearly demonstrate that *Jatropha curcas* can represent an income generation opportunity for poor rural farmers, without compromising the food supply, due to its ability to grow on less-favorable soils or as hedge rows around food or fodder cropping areas. Eighty per cent (80%) of Kenya‘s expansive land area is marginal. Establishing biodiesel plants on such land has the potential to stem rural urban migration, increase income generation potential for poor families, create employment and reverse environmental degradation. However, for these benefits to be realized there is need for careful introduction of such programmes.

An important point of consensus reached at the IFAD-organized International Consultation on Pro-poor Jatropha Development (April 10-11, 2008) is the urgent need to investigate the true production potential and the corresponding agronomic treatments required to achieve reproducible high yields of *Jatropha curcas* in varied ecological environments. Therefore, in view of the above, there is need to identify the highest yielding accession of *Jatropha curcas* and to provide a method for micropropagation which are economical and allow production on a commercial scale of uniform quality, true-to-type, disease-free plants.

Acknowledgement

I wish to extend thanks to the many people that made the writing of this proposal possible. First, I would like to thank Prof. (Mrs)

Eucharia Kenya, Department of Biochemistry and Biotechnology, Kenyatta University for conceiving the idea of the research proposal and for providing support in the development of the proposal. Secondly, i would like to thank Dr. James Onchieku and Mr. Joseph Machua of Kenya Forestry Research Institute for their support and for providing me with material and ideas which were useful in the development of the proposal. I also acknowledge the support provided by Mr. Daniel Okun of Kenyatta University. Thanks to my colleagues at Kenyatta University for being helpful in the development of my proposal.

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