



Ethanol micro-distillery plant in Ogbomoso: A case study of biofuel production in Nigeria

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Abstract

In Africa, a large population of people have been exposed to respiratory diseases as a result of Greenhouse Gases (GHG) generated during the burning of polluting fuels. Biofuels as an alternative source of clean energy emerged to ensure local and industrial users are free of air pollution. This paper elucidates the establishment of an Ethanol Micro-Distillery (EMD) plant in Ogbomosho Nigeria with a focus on the processes for ethanol production of 1,000 L per day capacity using cassava.

Keywords: Greenhouse Gases (GHG), Biofuel, Air pollution, Ethanol production, Cassava

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1. Introduction

In the Sub-Saharan African region, Nigeria is one of the highest emitters of Greenhouse Gases (GHG) generated from burning fossil fuels which has tremendously contributed to air pollution across the states; hence it has become very paramount for the production of biofuels as alternative energy to curtail this threat to the environment that can as well lead to climate change. According to Nigerian Biofuel Policy and Incentives, one of the objectives and potential benefit of adopting biofuel includes a drastic decline in emissions and ozone layer depletion to reduce the effect of atmospheric pollution caused by fossil fuels (Galadima et al., 2011). The aim of this paper is to showcase the production of ethanol from bioresources in Ogbomoso and recommend sustainable exploitation of these resources for the locals and the international market.

According to social bioethanol fact sheet, about 2.6 billion people are dependent on fossil fuels such as animal waste, wood and charcoal to cook; this results in about 4.3 million deaths every year due to respiratory complications caused by inhaling toxic smoke. The emergence of biofuel has greatly impacted the eradication of using the earlier mentioned fossil fuels.

Biofuels are products that can be processed into liquid fuels for transport, power generation or heating purposes. Biomass is a biological material that results in the production of biofuels; biomass is composed of feedstock required for transformation to biofuels. There are a variety of biomass materials in Nigeria, this includes residues from the forest, wood, food industries; crops, industrial wastes and animal droppings (Edirin and Nosa, 2012).

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Nigeria is advancing in large scale production of cassava and its accessibility as well as availability throughout the year has made it a reliable feedstock for biofuel production; it is estimated that about 15 tons of cassava can be recovered per hectare of land making it suitable to sustain commencement of bioethanol production in the country. Cassava is naturally a root tuber with high starch content which qualifies it as a high yield feedstock for producing bioethanol (Adewuyi, 2020).

Global production of biofuels has doubled in the last five years and will likely double again in the next four years, according to the UN framework. Generally, several factors have necessitated the need to move towards a sustainable energy development path in Nigeria. These include the need to contribute to efforts in reducing the GHG emissions, uncertainties in the global crude oil prices due to social and political instability currently caused by the Covid-19 pandemic, the finite nature and uneven distribution of petroleum resources, dependence of many countries on foreign exchange to cover their domestic energy needs and ultimately poverty alleviation via employment opportunities and development of rural areas. Presently, Nigeria has joined the already moving train with viable and sustainable energy alternatives that burn more cleanly.

With the establishment of Ogbomoso Ethanol Micro-Distillery (EMD) plant having a production capacity of 1000LPD, its impacts on the average Nigerian families and farmers include access to clean energy for cooking, reduction of indoor air pollution causing respiratory-related illness, generation of electricity, improved standard of living via increased cassava (feedstock) plantations and job creation and on the environment; reduction in deforestation, conservation of biodiversity and reduction in the emission of GHG on a local and regional scale.

The establishment of the plant was birthed by the vision and core mandate of the National Biotechnology Development Agency (NABDA). Technical expertise on operational activities was provided by the scientific officers in the agency and the collaborative effort between the agency and the factory employees serves to bridge the gap between academics and industries through research and development on problems associated with ethanol production. Also, the Federal Government of Nigeria through the ministry of Agriculture seeks to implement sustainable schemes to support cassava farmers and out-growers to subsidize the price per ton of the feedstock used at the ethanol plant. With this scheme, cassava will be readily available at the EMD plant at a lesser price compared to what is obtainable in the market. Thereby, reducing the total production cost annually and making ethanol affordable for every Nigerian.

Green Social Bioethanol (GSB), a company from Brazil, the second largest ethanol-producing country after the USA, has been known to be a good provider of micro-distilleries components over the years, supplied the Ogbomoso EMD plant with the facility set up. The components provided by the GSB are based on improved technology as the whole facility is simple, easy to operate and replicate. The simplified technology present in Ogbomoso has attracted potential investors and existing ethanol producers in the country to understudy the process of simultaneous saccharification and fermentation, SSF (uncooked slurry process). The process is



Figure 1: Cassava feedstock



Figure 2: Fermentation tank

energy efficient since no energy is spent on the jet cooker to heat the slurry and cool down before fermentation takes place thereby reducing the total cost of production in contrast to the conventional process of ethanol production.

2. Methodology

The methodology adopted by the ethanol production includes various processes from peeling of the feedstock to the final ethanol product. The feedstock (cassava) was gotten ready by shredding to 0.8 mm because the smaller the particles the higher the surface area, this was then washed, peeled and milled. The milled cassava was followed by dilution with water in ratio 2:1 after which the solution was homogenized for 6-12 h and pH adjusted to 4.5 with the aid of sulphuric acid to prevent damage or inhibition of enzyme, cold enzyme was added (combined alpha and glucoamylase) to enhance liquefaction and saccharification, followed by antibiotics. The resulting mixture was homogenized, yeast sample was prepared and added to the mixture in the fermentation tank and homogenization continued for 72-96 h. The alcohol percentage was checked to ascertain the sample is ready for distillation. The distillation process was carried out to obtain the ethanol.



Figure 3: Distillation unit

3. Conclusion and recommendation

In conclusion, with the aforementioned social, environmental and economic benefits derived from a single EMD plant present in Ogbomoso, coupled with the improved technology for cassava-based ethanol production by the GSB, it is of no doubt that micro-distilleries of this present capacity (1000 LPD) and more can be replicated in different parts of the country through supportive schemes and policies by the Nigerian government towards sustainable development projects.

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