International Journal of Innovative Scientific & Engineering Technologies Research 13(1):69-73, Jan-Mar., 2025

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doi:10.5281/zenodo.14799758

Production Of Biogas From Elephant Grass Using Cassava Vinegar As Mixing Liquid

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ABSTRACT
The study of the yield of biogas produced from elephant grass using cassava vinegar as the mixing liq uids is reported. The elephant grass was cut from Ekiadolor, Edo State. The grass was processed into feedstock using hand-grinding machine. Liquid extract from cassava is obtained through fermentation process. The soured cassava water is considered as vinegar with hydrogen potential (pH) of approxim ately 4. Three 50 litres gallon digesters were fashioned. One digester contains 20000g of the feedstock mixed with water, another one contains 20000g of the grass feedstock mixed with the cassava Vinegar and the remaining one contains only the cassava vinegar. The set ups were observed for 28 days. All t he trials produced biogas after 4 to 5 days Of fermentation as observed through the indicators and con firmed using flame test. The daily biogas yield was measured by calculating the volume increase Of th e indicator which is a tricycle tyre tube and the ambient temperature recorded. The digesters containing combination of elephant grass and cassava vinegar gave the highest y ield, 2.6 litres. The results from t he experiment show that a great improvement in biogas yield is achievable when cassava vinegar is us ed to mix the elephant grass instead of water. The result is an indication that cassava water serves not only as a mixing liquid but also an additive to improve the yield Of biogas from anaerobic digestion.
Keywords: Production Of Biogas, Elephant Grass, Cassava Vinegar,

INTRODUCTION

Biogas is organic energy source. It is a renewable energy source that is produced when organic matter, such as food or animals dung is broken down by microorganisms through anaerobic process. The production of biogas is achieved mostly in a closed system; the system is airtight such that the process is completely anaerobic digestion. Biogas consists mainly of methane and carbon dioxide and small am Counts of hydrogen sulphide, siloxanes and some moisture. Methane and carbon dioxide are greenhouse gases. These gases can be extracted from their sources and utilized for fuel in this process and will h CIP protect the environment. Grasses such as elephant has high yield of methane gas (Delgado, Galind o, Gonzalez, Gonzalez, Scull, Dihigo, Cairo, Aldama, Moreira, 2012). A vast majority of countries espe cially developing countries have energy crises with over reliance on fossil fuels (Mohammad, Mohama d, Ishak, Mustapa, and Ayodele, 2021). In Nigeria, the demand for energy supply today is more than eve r; the country's population is increasing, the competition for energy allocation is fierce, and industries a re being established with inadequate energy chain supply. In the rural areas, 80 million people are out o f electricity coverage (Rural Electrification Agency); they are cutoff from national ener gy grid leading to

explosion Of rural to urban migration, and because Of that, the energy for domestic a nd industrial activities is undersupplied. Forest reserves are depleted as over 85% of rural dwellers depe nd on wood for domestic heating; this activity certainly, increases ozone layer depletion with its advers e effect on environment. Environmental concerns demand that a shift from fossil energy resource to a cheap and environmental friendly energy source is highly needed. This is a key to economic growth an d environmental sustainability. As of last two years, 2023 and 2024, the cost of energy supply in Nigeri a is very alarming; a liter of kerosene was sold for HI 700 as against N900 in the preceding year while 1 kg Of cooking gas was sold between NI 400 and NI 500 as against N700 in the previous year. Currently in the country, a liter of premium motor spirit is sold between NI 080 and N1200 depending on the Iocation. Because of the high cost of these products, the cost of running livestock farms in the country becomes very high and as such, greater percentage of small scale farmers are not coping and are on the verge Of closing productions, leading to high cost Of livestock produce. In the mixed of this energy cries in Nigeria, biogas is a potential remedy. Biogas is competitive, viable, and generally a sustainable energy resource due to abundant supply of cheap feedstocks and availability of a wide range of biogas applications in heating, power generation, fuel, and raw materials for further processing and production Of sustainable chemicals including hydrogen, and carbon dioxide and biofuels. The capacity Of biog as based power has been growing rapidly for the past decade with global biogas based electricity gene ration capacity increasing from 65GW in 2010 to 120GW in 201g representing a 90% growth, (Moses Jeremiah Baraga Kabeyi and Oludolapo Akanni Olanrewaju, 2022). The potential of biomass in remedying energy crises in developing countries has not been realized by some governments Of the countries. Despite the abundance of natural biomass materials in the rural areas, biogas production in Nigeria has not been given adequate attention by the government at all levels. The government of Nigeria relies so much on fossil fuel. Fossil fuel has been predicted to be greatly depleted in the next ten decades (citation), and also, because Of increased concerns on climate change occasioned by constant release Of greenhouse gases to atmosphere, it is no longer an option to fall back to nature for solution," this can be found when alternative sources of energy is sought after and adequate policies and budgetary allocation given to the production Of environmental friendly source energy. The importance of biogas production from agricultural products has also been Of interest as a source Of energy supply in various countries (Lebuhn and Gronauer, 2009). Biogas is not only an alternative but also destination as it has the potential to fill the gap of inadequate supply of energy (Moses and Oludolapo, 2022). Many substrates have been used in the production Of biogas [Clarke, et a, 2008; Almoustapha, et al, 2009; Patil, et ad 2012; Si nghal, and Rai, 2003, Adam and Shanableh, 2015; 3amidele, e! a/' 20171" Mallik, et a/ (1990)," Ogunwa nde, et a/ (201 5); Alvarez, et al et al, (2007); Yong, et al, (2015)) including elephant grass (Victor, etal 2021), Research on biogas design and development has been extensively showcased in literature of Energy sources (Ahmadu, (2009); Chippa, and David. (2011); Hullo, (2012); and Cioabla, (2014); Ocwieja, (2010); (201 1). ojo, eta/, (2007); RObjy, etal (201 3); syed, (2006); Widodo, and Hendriadi, (201

Some approach has been used to improve the yield and quality of biogas production from elephant grass. Liquid extract from plantain pseudo stem has been found to produce very high quality of biogas i n terms of methane content, but at IOW yield rate Mbachu, and Alukwe, (2019).

This research work sought a way Of improving the quality yield Of biogas from elephant grass using fermented cassava extract as mixing liquid in place of water.

The choice of elephant grass by the authors is due to the fact that elephant grass is the major forage f or cows in the rural area Of Ekiadolor in OVia North-East Local Government area Of Edo State where the researchers collected the samples, and the availability of the grass in large quantity in the rural areas. In addition, cassava farming and processing is the pre-occupation of the locals of Ekiadolor. Thus, the researchers found it interesting to consider using this cassava water which is usually poured out as wa Ste after sieving as mixing liquid for the selected substrates and compare the yield Of biogas using the vinegar and borehole water.

The determination of improved yield of biogas using extract of cassava will provide additional data for producers of biogas to have a better mixing option in their production.

About Elephant grass (*Pennisetum purpureum* Schumach.). Elephant grass is a species of perennial tropical Cadeep-rooted bunch grass native to eastern and central Africa (Boonman 1997). It can grow f rom sea level up to altitude of 2000 m. When grown at altitude above 2000 m, growth and regeneration after cutting is slow and it may die due to frost (Francis 2004). It is robust, rhizomatous, tufted and has a vigorous root system, developing from nodes of its creeping stolons. The culm is coarse, and may be up to 4—7 m in height. The plant can form dense thick clumps, up to 1 m across. The leaves are flat, lin ear, hairy at the base, up to 100 — 120 cm long and 1 — 5 cm wide, bluish- green in color. The inflorescе nse is a stiff terminal bristly spike, up to 15 — 20 cm in length, yellow-brown to purplish in color. Spikele ts are arranged around hairy axis. There is little or no seed formation. When seeds are present, they a re very small (Mannetje 1 g92," Francis 2004). Elephant grass can be propagated through seeds, howeve r as seed production is inconsistent, collection is difficult Alternatively, it can be propagated vegetative ly by stern cuttings or stolons. After planting, elephant grass grows vigorously and can reach 4 m in 3 months (Skerman and Riveros 1 ego).

Chemical composition Of elephant grass: The range Of protein content Of elephant grass has been rep orted to varies from 4 to 20.4% With the mean around 12% (Muhammad Rusdy, 2016; Xie et al , 2009) Fibre content of elephant grass range from 63.9 to 75.4% (Lounglawan et al (2013)). Fresh elephant gr ass nutritious to man. Some people from Igbo extraction of Nigeria use it for soup. Nebo people of ebo nyi State can cook fresh elephant grass together With gene-seed and draw soup like Okra and "Ogbono."

MATERIALS AND METHOD

Sample Collection and Preparation

The cassava tubers were obtained from a farm in Federal Collegeof Education Technica I Ekiadolor, Edo State of Nigeria. The grass was also collected from the same Federal Col lege of Education Technical, Ekiadolor. The cassava tubers were peeled to remove the ba rk, the White tubers weighing 45kg were cut into smaller pieces, afterward, it was stacked in 75 litres Capacity plastic drum and 30 litres of water was introduced into the drum. Th e cassava was allowed to stay in the container for seven days to decay thereby produce d soured water. After that, the solid cassava was removed and the vinegar was filtered u Sing sieve and the filtrate was collected and stored in a container. The elephant grass wa s chopped into small strands and then grinded using hand-grinder to produce the feedst ock

Components Of the Design

The digesters used for the experiment were three gallons of 50 liters each. The gallons w ere constructed by drilling two openings on the covers. One opening was fitted with gas outlet hose which is connected to the indicator (tricycle tube in this case) and the tap usi ng T-hollowed pipe while the other opening was fitted with IV tubing which was used for the flame test. These opening were adequately sealed to let no air enter the digester.

Mixing Of the samples

The feedstock from the grass was weighed and 20000g of feedstock was mixed separat ely with water and the cassava water. One of the digesters was two-third filled with the fe edstock mixed with cassava water. Similarly, the other digester was two-third filled with t he feedstock mixed With water from the borehole While the remaining digester was two-t hird filled with the cassava water only which served as the control. The experiments were observed for 28days,,

The temperature of the system is taken daily and the gas formed was weighed for 4 peri odsof seven (7) days each.

RESULTS AND DISCUSSION

Table 1 , Daily production Of biogas With temperature

	Cassava water	Feedstock with water L/day	Feedstock with cassava water L,fday	Temperature
				30
Day 2	07	1 .2	1 .5	33
		1 .3	2.6	34
		1 .5		

Biogas started forming in each of the set ups from 4 to 5 day of the experiment, with the one mixed with cassava vinegar inflating the (indicator) more than the one mixed with water as shown in the above table. This is evidence that cassava vinegar improves yield of biogas from elephant grass through anaerobic process.

The daily biogas yield was measured by calculating volume increase of the indicator which is tricycle tyre tube. 2.6 litre of biogas was produced on the Day 3 at the temperature of 34^0C

Note that Day 1 represents 7 Days or a period in this case.

CONCLUSION

Form the result obtained from the experiment, it could be seen that the yield of biogas produced from elephant grass improved through the use of cassava vinegar as mixing liquid and additive.

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