Bio gas Production from Jack fruit (Artocarpus heterophyllus)

Suryanarayana.K
Department of Physics
Srinivas Institute of Technology,
Mangalore, Karnataka, India
surya_nekkare@yahoo.com

Mahesha.K
M.Pharm,
Srinivas College of Pharmacy
Mangalore, Karnataka, India
masha@nekkare@yahoo.com

Abstract

The over production of jack fruit (Artocarpus heterophyllus) during harvest season and its short self-life have caused serious losses for farmers. The unused jack-fruit and its parts also produce environment pollution in the form of odd smell. Since it is easily biodegradable we can use it as source for bio gas production. The present work deals with the formation of Biogas from jack-fruit and its wastes. A small biogas plant is fabricated for this purpose. The quantity of biogas obtained from Jack fruit flesh, Outer part of Jack fruit, Mixture of all the part of jack fruit and Jack fruit seed are measured. It is found that jack fruit produces good amount of biogas compared to cow dung with the limitation of taking long time for decay process. It is found that 1 kg of jackfruit flesh, Outer part of Jack fruit, Mixture of all the part of jack fruit and Jack fruit seed can produce biogas of about, 21.3L, 24.8L 16.8 L and 27.5L respectively.

Key words: Fermentation, Biogas, cow dung, Biogas plant

I. INTRODUCTION

The **jackfruit** (*Artocarpus heterophyllus)* also known as **jack tree**, **jakfruit**, or sometimes simply **jack** or **jak** is a species of tree in the *Artocarpus* genus of the mulberry family (*Moraceae*). It is native to parts of South and Southeast Asia, and is believed to have originated in the south-western rain forests of India, in present-day Kerala, in Tamil Nadu, coastal Karnataka and Maharashtra. The jackfruit tree is well suited to tropical lowlands, and its fruit is the largest tree-borne fruit reaching as much as 40 kg in weight, 36 inches (90 cm) in length, and 20 inches (50 cm) in diameter.

The overproduction of jackfruit (Artocarpus heterophyllus) during harvest season and its short self-life have caused serious loss for farmers. The waste product also produces environment pollution. It is also very interesting that the all parts of jack-fruit is degradable and is a good source of cooking gas. For this experiment we designed a small bio-gas plant of our own using a 60 liter

and 50 liter fiber cans and small other accessories. Using this we studied the bio-gas formation quantity from jack fruit flesh, the outer cover, jack fruit seed and all the unusable parts together etc. We found that in each case we got a good amount of cooking gas. We did the comparative study of bio-gas formation in different cases.

Biogas technology provides an alternate source of energy in rural India, and is hailed as an archetypal appropriate technology that meets the basic need for cooking fuel in rural areas. Using local resources, viz. cattle waste and other organic wastes, energy and manure are derived. On this basis we started to work on the bio gas production from the jack fruit flesh and other waste parts of the fruit. For this experiment we fabricated our own bio-gas plant.

Experimental

Components of the Bio-gas Plant:

The major components of the bio-gas plant are a digester tank, an inlet for feeding the waste biodegradable material, gas holder tank, an outlet for the digested slurry and the gas delivery system for taking out and utilizing the produced gas.

Materials required:

1. Empty PVC can 60 L capacity: 1 (to be used as Digester Tank)
2. Empty PVC can 50 L capacity: 1 (to be used as Gas Holder Tank)

3. 60 mm diameter pvc pipe: about 40 cm long (to be used for feeding waste material)
4. 30 mm diameter pvc pipe: about 20 cm long (fixed on digester tank to act as outlet for digested slurry)
5. M-seal, water-proof adhesive
6. Gas outlet system: ball valve, couplers and flexible Gas pipe

7. A single burner bio-gas stove or a Bunsen burner

Different steps:

1. The 60 L and 50 L capacity PVC cans are brought; second one should fit inside the first one.

(fig1.a and 1.b)

2. 60 mm PVC pipe will be used for feeding the jack fruit is fitted to inverted 50 L tank
3. Gas outlet system with ball valve and water proof couplers and flexible Gas pipe is fitted
4. A small piece of 12 mm diameter pipe will be used as outlet for the slurry at the top side of the 60 L tank.
5. One additional out let is kept below it if any need of removing excess slurry.
6. Completed biogas tank is shown in fig 1.c. and burning gas is shown in fig 1.d.

***Biogas production method**:*

Initially, cow-dung mixed with water in 1:1 ratio will be fed in to the system, which will start the gas formation process. The gas holder will rise based on the amount of gas produced. Subsequently, the jack fruit flesh or other parts will be diluted with water and used to feed the system. We can add some weight on top of the gas holder to increase the gas pressure. When we feed the system, the excess digested slurry will fall out through the outlet pipe, which can be collected, diluted and used as organic manure.

Initial production of gas will consist of oxygen, methane, carbon dioxide and some other gases and will not burn. These gases can be released to the atmosphere by opening the ball valve at least three / four times. Subsequent gas can be used in burning Bunsen burner or a bio-gas stove.

***Analysis**:*

We analyzed the production of gas with different materials in our system. It is reported [2] that the following consumption rates in liters per hour (L/h) can be assumed for the use of biogas:

- household burners: 200-450 L/h
- industrial burners: 1000-3000 L/h
- 1 kg of cattle dung delivers 40 L of *biogas*

On this basis we calculated the production quantity of gas.

***Calculation**:*

- Considering the house hold burners using an average of 320 L/hour.
- Average of 320 L of gas can be used for 1 hr (3600 s).
- Therefore As 1 L of gas can burn for 11.25 second, 1kg cow dung produce 40L gas can be used for 450 s.
- In our set up we observed that 1 kg of cow dung produces gas which can be used for about 220 sec. Continuously for 7 days we observed and taken the average value.
- Thus we can conclude that 1 kg of cow dung produces about 19.5 L of gas.
- The difference in the quantity may be due to constructional defects.
- By taking this as reference we conducted the experiment to verify the gas production from the jack fruit.

Table I: comparison table of biogas from different materials per Kg

For initialization the cow dung is needed

Si.No.	Material	Minimum Time needed to produce the gas (in days	Time of cooking gas available (T in sec)	Quantity of gas in liter (T/11.25)
1	Cow dung	1	220	19.5
2	Jack fruit flesh	2	240	21.3
3	Outer part of Jack fruit	4	280	24.8
4	Mixture of all the part of jack fruit	7	190	16.8
5	Jack fruit seed	12	310	27.5

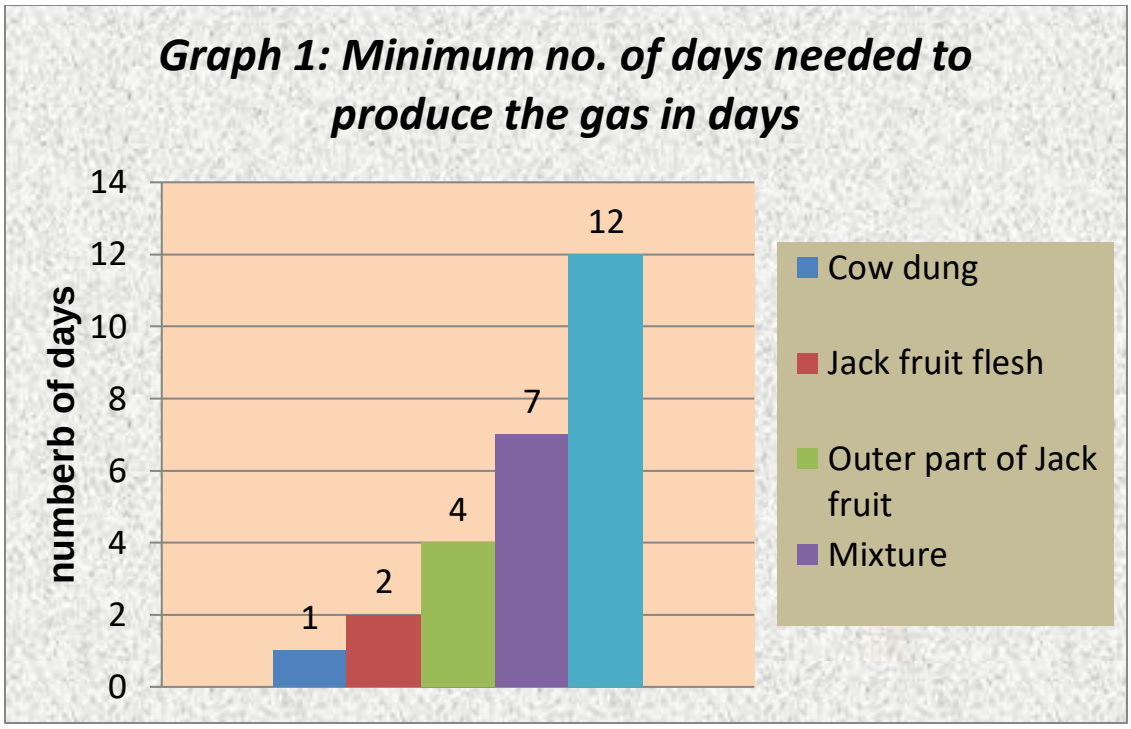
Fig1: Different stages of bio gas plant

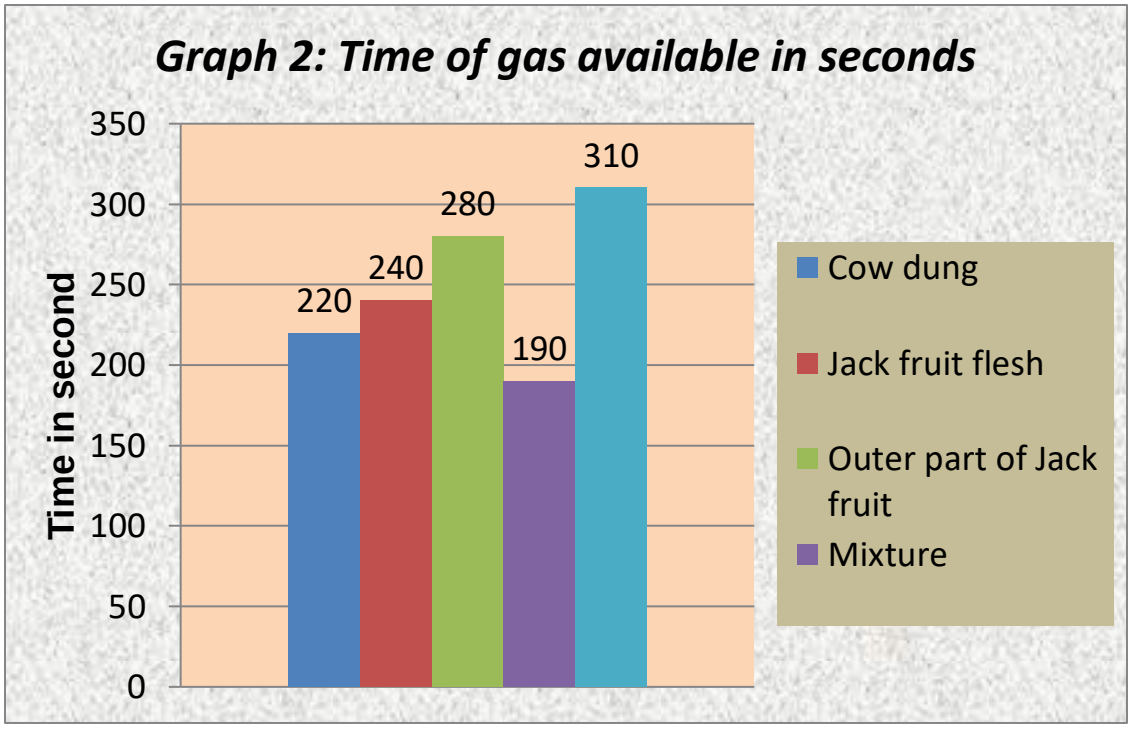
a. 60L can

b) 50L can

c. Completed plant

d. Burning gas


Graph 1: Minimum no. of days needed to produce the gas in days
numberb of days
14
12
10
8
6
4
2
0
1
2
4
7
12
Cow dung
Jack fruit flesh
Outer part of Jack fruit
Mixture


Graph 2: Time of gas available in seconds
Time in second
350
300
250
200
150
100
50
0
220
240
280
190
310
Cow dung
Jack fruit flesh
Outer part of Jack fruit
Mixture

Conclusion

- The over production of jack fruit during harvest season and its short self-life have caused serious losses for farmers
- The production of cooking gas from jack fruit helps the village people to use the wastage as the source of energy.
- Same set up can be used to produce the gas from other biodegradable waste materials like food waste, vegetable wastes etc.
- The energy from waste is the main theme of this work
- The excess slurry from the biogas plant can be used as manure for the plants
- Jack fruit is good source of cooking gas
- Jack fruit seed contains good amount of gas, but it takes more time to produce the gas
- The mixture of all the parts of jack fruit give less quantity of gas , may be due to the slow decomposing materials like the outer cover of the seed

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