Advances in life science research

# Evaluation of methane production potential from livestock manures and their effect on the growth of *Impatiens balsamina*

Sapna Kinattinkara[a]|Thangavelu Arumugam[b*]

[a]Department of Environmental Science, PSG College of Arts and Science, Coimbatore – 641014.

[b*]Department of Environmental Studies, Kannur University, Kerala – 670567.

Corresponding author email: thangavelgis@gmail.com

## ABSTRACT

Soil is the uppermost thin layer of earth's crust which is the natural medium for the growth of plants .The objective of the study was to compare the Rabbit dung and cow dung on the growth of Impatiens balsamina, to compare the methane production of rabbit dung and cow dung, and to check whether rabbit dung and cow dung can be used as an alternative to soil. Collection of seeds and fresh rabbit dung and cow dung were collected from in and around Kangarappady, Ernakulum. They were dried and crushed to make it in a powdered form. Seeds of Impatientsbalsamina seeds were also collected from a single parent plant. The potting mix were prepared transferred to respective pots. The analysis was terminated on the thirtieth day. Various plant characters like plant height, number of leaves, number of flowers and total fruit weight were noted. Plant height (cm) was taken as the distance from the upper portion of the pot to the highest point of the plant stem.The result shows the morphological characters of the plants of each pot after 40 days. It shows the rabbit dung produces higher amount of biogas when compared to cow dung. It is also found that the maximum amount of biogas can be produced after 3 days of anaerobic digestion.

## KEYWORDS

Balsamina, Coudung,Rabbit dung, Plant growth, Soil.

## INTRODUCTION

Soils are the essential resource for supporting agriculture and forestry. It is an important pool of active carbon and plays an important role in carbon cycle (Chandra Sharma2015). Rabbit manure improves media properties, water holding capacity and cation exchange capacity (CEC) which reflects on the improvement of plant mineral uptake and plant growth. Rabbit manure improves chemical properties by providing cation exchange capacity. It is also a source of macro and micronutrients (Abd-Elmoniem et al. 2001). Abhishek et al. (2014) found that using compost with media improves plant growth and yield, which is also a favorable condition for root growth and uptake rate. In addition, Aleksandra (2014) found that using manure in soilless culture improve plant growth and yield. On the other hand, Babatola(2008) reported that mixing the recommended amounts of organic manure into substrate, prior to planting; improve plant vegetative growth by providing sufficient nutrient source for plants. The different manure types at equal applied rates provided equivalent amount of nutrients to plants. Based on ease of availability, collection and nutrient composition and nutrient composition, poultry manure is thereby suggested for maize growers for higher yield per hectare in the humid ultisols environment. (Law-Ogbomo et al. 2017; Sapna et al. 2020).

The degree to which manure affects soil depends on the physical and chemical properties of the manure itself and various management and environmental factors including rate and timing of application, soil type, and climate. (Amanda 2008; Rayne and Aula 2020).Evangeline (2019) conducted a study to determine the effect of different mixtures of organic and inorganic local and imported materials on vegetative growth and yield of pepper (*Capsicum annuum* L.) and eggplant (*Solanum melongena* L.) The organic and inorganic materials used in this study were peat moss, perlite, sand, peanut crushed husk, and rice hull. Cajeput (*Melaleuca leucadendron*) waste has the potential to be used as raw material for organic fertilizer. A Significant increase in soybean production was found with application of cajeput waste compost (Isnatin U et al, 2017). Research aimed to study the application of organic fertilizers and Trichoderma asperellum to increase growth and yield of shallot. This treatment increased plant height by 8.11 % until 25.00 % compared to all treatment combinations. (Parwi et al. 2004). A type of rabbit compost consisting of solid manure (feces) which becomes fertilizer to increase crop production. (Adi et al. 2020).Li Yingjuan (2013) conducted a study to obtain the biogas fermentation potential of rabbit dung by the anaerobic batch fermentation experiment. The purpose of the all is to find a method to reach the both of economic and environmental accordance.

The research on anaerobic digestion has increased over the years due to the important of biogas in many homes and industries in the world. Renewable energy such as biogas has contributed immensely to meeting the energy need of many people across the globe.The renewable energy usage is increasing gradually due to negative effect associated with the use of non-renewable energy. This studied investigated different biogas volume obtained during anaerobic digestion of rabbit waste and swine dung. It was observed that the maximum biogas volume was recorded in the digester with swine dung. (Ofili et al. 2015).Babatola (2008) conducted a laboratory-based work which compared Biogas yield patterns in some animal and household wastes. The use of animal manure for production of biogas has positive environmental impact due to reducing carbon dioxide ($CO_2$) and methane ($CH_4$) emissions - the cause for global warming. According to Executive Environment Agency, the share of emissions of methane, emitted by the agricultural sector in Bulgaria, occupies 18%. Present situation with increasing energy demand in world scale also stimulates processing animal manure for biogas production. Bulgaria's national energy target for 2020 presumes the share of energy from renewable sources in the gross final consumption of energies to achieve 16%. Thus, the production and higher use of biogas will be necessary to reach this national target. Biogas production from animal manure in Bulgaria is still un developed due to high starting investments; despite there is a high potential for its future implementation. The recently introduced Renewable and Alternative Energy Sources and Biofuels Act with very good feed-in tariffs (ranging between 433 and 119 BGN per kWh) has led to an increased interest to construction of biogas plants in the last time. (Zaharievet al. 2014).

Based on turning waste into wealth and improving utilization efficiency, this experiment is designed to study the biogas fermentation potential of the rabbit dung, which will give a scientific evidence for rabbit organic waste utilization (Uzodinma and Ofoefule 2009). Rabbit feces are a concentrated source of fiber and could have commercial potential both as input biomass in anaerobic processes for biogas production, as well as a fibrous source for ruminal degradation. (Pier Giorgio Peiretti et al. 2014; Sapna et al 2022).Other issues such as the best methods to process and distribute biogas should also be analyzed before biogas production and use are implemented in widespread fashion. (Amanda D Cuellarand Michael E Webber2008).Therefore, utilization of a 'green' energy source, which is eco-friendly, one that would improve living conditions, health standards and the environment is necessary in meeting the energy demand, hence the research on biogas. (Evangeline A Diagiet al. 2019). The aim of the objectives are to compare the Rabbit dung and cow dung on the growth of Impatiens balsamina, to compare the methane production of rabbit dung and cow dung. and to check whether rabbit dung and cow dung can be used as an alternative to soil.

## MATERIALS AND METHODS

*Collection of seeds and dung*

Fresh rabbit dung and cow dung were collected from in and around Kangarappady, Ernakulam. They were dried and crushed to make it in a powdered form. Dried and powdered cow dung is shown in figure 1. Dried and powdered rabbit dung is shown in figure 2. Seeds of *Impatientsbalsamina* seeds were also collected from a single parent plant.

Fig 1: Balsamina

Fig 2.Cow dung

Fig 3. Rabbit dung

*Planting and assessment of themorphological characteristics of the plant*

5 plastic pots (12cm x 11cm) were taken and marked as follows. The potting mixes were prepared transferred to respective pots as shown in figure 3. Pot A was prepared by mixing 1 part of Rabbit dung in 2 parts of soil. Pot B was prepared by mixing 1 part of cow dung in 2 parts of soils. Pot C was prepared by adding soil only. Pot D was prepared by adding rabbit dung only. Pot E was prepared by adding cow dung only. Seeds of *Impatiens balsamina*(figure 4) were sown. The potting mixes were shown in table 1.

**Fig 5: Seeds of Impatiens balsamina**



**Figure 4: Pot A, B, C, D, E after adding potting mix**

2.3. Methane production cow dung and rabbit dung

Rabbit dung and cow dung were taken separately and introduced into 250ml biogas bottles. The bottles were fixed with anaerobic assembly by plugging with rubber stopper and cork as shown in figure 6&7. Methane production were measured for 5 days after the 1 day of anaerobic digestion using saccharometer. The total biogas productions were measured using water displacement method. Duplicates were performed and the average values were calculated.

**Table 1: Table showing potting mixtures in different pots**

| POT | POTTING MIX |
|---|---|
| A | Rabbit Dung + Soil |
| B | Cow Dung + Soil |
| C | Soil |
| D | Rabbit Dung |
| E | Cow Dung |

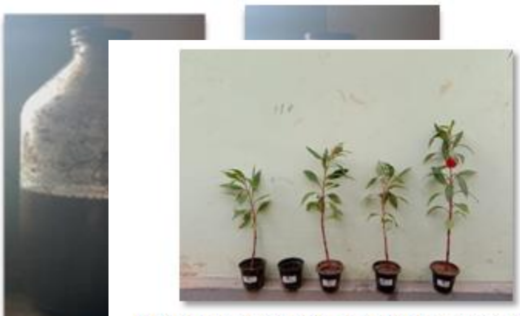

Figure 9: Seed germination in all pots after 1 week

Fig 6: Biogas bottle containing cow dung.

Fig 7: Biogas bottle containing rabbit

The methane production was estimated for 5 days of anaerobic digestion. Saturated solution of KOH was filled in the saccharometer using a standard 5ml syringe with a long needle the gas sample was withdrawn from the biogas bottles and carefully injected to the saccharometer such that the gas displaces the solution. The $CO_2$ present in the biogas will be dissolved in the alkali solution and methane will be collected at the top of the saccharometer. The volume of alkali displaced is the content of the methane (Eq.1).

$$\text{Methane content} = \frac{\text{Volume of dissolved biogas X 100}}{\text{Volume of biogas injected}} \quad \text{------ (1)}$$

The total biogas produced were measured after 5 days by water displacement method. The volumes of biogas produced were determined using plastic syringes. A measuring cylinder was filled with water and kept upside down on a water tub. The biogas in the biogas bottles were syringed out through a tube and the other end was inserted into the measuring cylinder. The volume of water displaced by the entry of biogas gives the total biogas production.

## RESULT AND DISCUSSION

*Morphological characters*

Pot A: Seed germinated after 1 week. This pot showed the maximum height, maximum number of flowers and maximum number of leaves. Along with the plant, there were many weeds. Weeds were removed by hand picking. It also had large leaves when compared to other pots. Maximum girth was found in this plant.

Pot B: Seed germinated after 1 week. This pot also had better characters but less than pot A. This pot also had weeds and it was removed.

Pot C: Seed germinated after 1 week. It had normal plant characters. There were no weeds. Flowering was delayed in this pot.

Pot D: There were no seed germination. After 1 week a sapling was planted to the pot. The plant survived for 3 days and the plant doesn't have a significant growth. Finally, the plant died. Insects like ants were always found on the pot.

Pot E: seed germinated after 1 week. There were more weeds when compared to other pots. This also had a characteristic growth but the growth stopped in last week. The flowering was delayed in this pot. Result after 1 week with seed germination is shown in the figure 8 &9.

Figure 8: Pot A, B, C, D & E after 1 week

The experiment was terminated on the 40th day. Figure 8&9shows the pots after 40 days.The morphological characters of the plants of each pot after 40 days are shown in the figure 10.

*Result after 40 days*

Pot A showed the maximum height (60cm) followed by Pot C (54 cm). The smallest plant was observed in pot E (40cm). Stem girth was also highest in pot A (8cm) and was lowest in Pot C (5cm). The maximum numbers of leaves were observed in pot A (30) and lowest in pot C (17). Pot A plant also had bigger leaves when compared to leaves of other plants. Number of flowers were also higher in pot A (14) and lower in pot C and pot E (4). Pot A had greater fruit weight (6.2g) since it had a greater number of flowers and Pot E had lower fruit weight (2g).

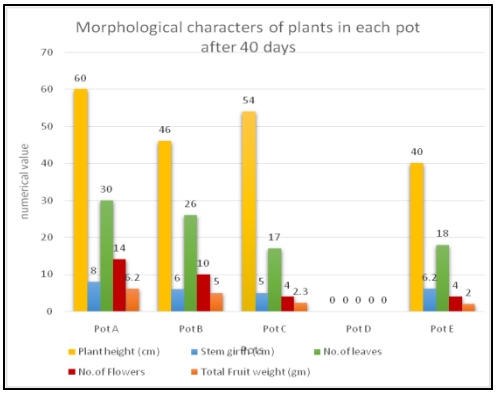

**Figure 10: Morphological characteristics of plants in each pot after 40 days**

Pot A had greater morphological characters when compared to other pots. Pot B also shows sufficient amount of growth but less than pot A. when comparing pot B and pot E since they both contain cow dung, Pot B shows more significant characters than pot E. Pot E stopped their growth in last week this can be due to the over availability of nutrients, but it supports plant growth. Pot D didn't support plant growth, it can be due to the presence of high nutrients.

*Biogas production*

The volume of biogas production was recorded daily for 5 days and its methane percent was also analyzed. The total biogas production of rabbit dung and cow dung is shown in figure 11. The methane production of rabbit dung and cow dung is shown in figure 12.

*Total biogas production*

The graph shows that rabbit dung produces higher amount of biogas when compared to cow dung. It is also found that the maximum amount of biogas can be produced after 3 days of anaerobic digestion.

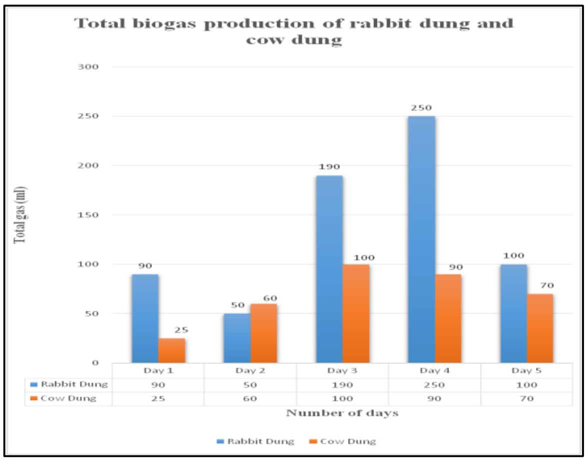


**Figure 11: Total gas production of rabbit dung and cow dung for 5 days.**

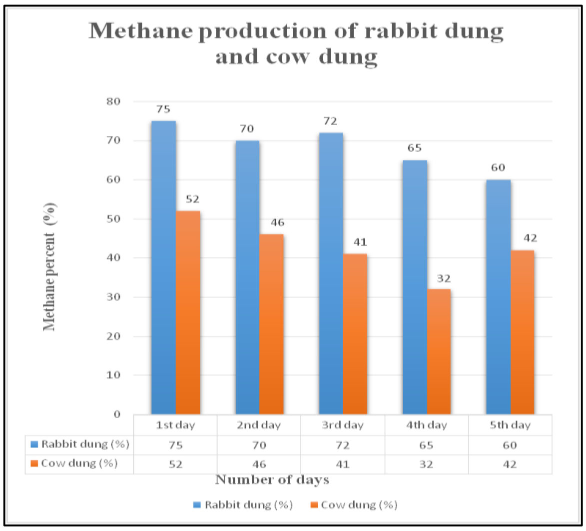


**Figure 12: Methane gas production of rabbit dung and cow dung for 5 days.**

*Methane production*

This graph shows that methane gas production is higher in rabbit dung than cow dung. Rabbit dung contains an average of 68% of methane. Cow dung contains an average of 44% of methane.

## CONCLUSION

The potting mix with soil and rabbit manure showed higher morphological characters such as plant height, stem girth, number of leaves, number of flowers, total fruit weight. This result shows that adding rabbit manure to potting mix allows faster plant growth and yield than cow dung. Rabbit manures can be used in agriculture as an organic fertilizer which has higher NPK values than cow dung and hence higher growth.

Rabbit manures cannot be used as an alternative to soil, since it contains higher amount of nutrients which makes unsuitable for the growth of plants especially young plants and seedlings. Cow dung can be used as an alternative to soil, but it doesn't allow germination. Cow dung is also high in nutrient content and it has odour issues. By using cow dung as an alternative to soil, there will be higher number of weeds growing along with the desired plant. Using fresh cow dung is not recommended since it has odour problems, it has high ammonia and salts which will burn the plants, it has harmful microbes which will harm the plant, and also had weed seeds. For using cow dung as an alternative to soil, it is advised to use dried dehydrated cow dung which eliminated all the problems of fresh cow dung.

Biogas production is higher in rabbit manure than cow dung. Rabbit dung is also rich in methane which make the biogas flammable. Biogas usually contains 50-65% methane. Rabbit dung produces 68% of methane and cow dung produces 44% of methane. Rabbit dung can be used along with organic waste like vegetable waste, garden waste etc to yield more amount of biogas. Even the slurry obtained after biogas fermentation can be used as manure to plants. This study investigates on the effect o f cow dung and rabbit dung on the growth of plant. The result showed that applying rabbit manure to the soil gives higher plant growth and productivity. Dehydrated cow dung can be used as an alternative to soil. Rabbit dung produces greater amount of biogas and methane gas which makes it perfect for the production of biogas. Since the world is running for finding alternative sources of energy, rabbit dung is excellent source for producing higher amount of biogas.

**REFERENCES**


Abdrabbo M. A. A., A. A. Farag (2008) Using different mixtures of organic and inorganic materials plus levels of rabbit manure to grow pepper and eggplant in pot culture,Animal Production Dept., Fac. Of Agriculture, Cairo University, 29-30

Abhishek Raj ,Manoj Kumar Jhariya , Pratap Toppo (2014) Cow dung for ecofriendly and sustainable productive farming,International Journal of Scientific Research . Vol.3 (10):201-202.

Adi P. T. S., Made Sri Yuliartini, Gusti BagusUdayana (2020) Effect of Rabbit Compost and NPK on The Growth and Yield of Zucchini (Cucurbita Pepo L.), SEAS (SustainableEnvironment Agricultural Science) Volume 04, Number 02, October 2020, pages: 151~156

Aleksandar Zahariev, DimoPenkov, Anna Aladjadjiyan (2014) Biogas from Animal Manure – Perspectives and Barriers in Bulgaria ,Annual Research & Review in Biology. Vol 4 (5). pp. 709-719.

Amanda D Cuéllar, Michael E Webber (2008) Cow power: the energy and emissions benefits of converting manure to biogas, Environ. Res. Lett. 3034002.

Babatola.J.O (2008) Comparative Study of Biogas Yield Pattern in Some Animal and Household Wastes,African Research Review Vol. 2 (4) : pp. 54-68.

Evangeline A Diagi (2019) Comparative Analysis of Biogas Produced from Cow Dung and Poultry Droppings, IOP Conf. Ser.: Earth Environ. Sci.331.

Isnatin U, Parwi, Mulyanto T (2017) Gontor AGROTECH Science Journal 3(2). pp. 119-130.

Law-ogbomo.K, osaigbovo A.U, Kadiri, I.H (2017) Influence of some animal manures on growth and yield of maize (Zea mays L.) under a humid ultisols environment, Journal of Organic Agriculture and Environment Vol. 5, No. 2.

Li Yingjuan, a, Liu Lichun , Yang Bin , Zhang Wudi , Yin Fang, Xu Ling , Zhao Xingling , Liu Jing , Chen Yubao , Liu Shiqing (2013) Experimental Study on Biogas Production by Mesophilic Fermentation for Rabbit dung , Advanced Materials Research Vol. 763 (2013) pp 160-164.

Natasha Rayne, Lawrence Aula (2020) Livestock Manure and the Impacts on Soil Health, A Review, Department of Plant and Earth Science, University of Wisconsin–River Falls, River Falls, WI 54022, USA

Ofili I, Ibrahim A.H, Orban M.O., Abur F.F, Okpanachi A.I (2015) Comparison of Biogas Yeild from Anaerobic Digestion of Rabit Waste and Swine Dung, Projects Development Institute (PRODA), International Journal of Advanced Engineering Research and Science (IJAERS) Vol-2, Issue-10, ISSN: 2349-6495.

Parwi, U Isnatin, M Hamawi, U Etica (2019) Growth and yield of Shallot (Allium cepa L.) in respons of organic fertilizers and Trichoderma asperellum,, Agrotechnology Department, Universitas of Darussalam Gontor, Indonesia, Journal of Physics: Conference Series ,1381 (2019) 012004

Pier Giorgio Peiretti, Sonia Tassoni, Francesco Gai, Laura Gasco, Giorgio Masoero (2014) Rabbit Feces as Feed for Ruminants and as an Energy Source.Vol.4. pp. 755-766.

Sapna Kinattinkara, Thangavelu Arumugam, Nandhini Samiappan, Vivek Sivakumar, SampathkumarVelusamy, Mohanraj Murugesan, Manoj Shanmugamoorthy (2022) Deriving an Alternative Energy Using Anaerobic Co-Digestion of Water Hyacinth, Food Waste, and Cow Manure, Journal of Renewable Energy and Environment, Vol 7(1-7) https://doi.org/10.30501/jree.2022.327715.1325.

Sapna Kinattinkara, ThangaveluArumugam, Kaarmuhil S P (2020) Surveillance of groundwater quality of selected rural and industrial areas of Coimbatore: A GIS Approach. IOP Conference Series: Materials Science and Engineering 955 (1), 012083.

Uzodinma, E.O, Ofoefule A.U (2009) Biogas production from blends of field grass (Panicum maximum) with some animal wastes,International Journal of Physical Sciences Vol. 4(2), pp. 091-095.