Study on biogas production from waste of an automated aquaponics module and self-sustaination feasibility

Estudo sobre produção de biogás a partir dos dejetos de um módulo automatizado de aquaponia e viabilidade de autosustentação

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ABSTRACT
The agricultural production chains have become, over the years, more important and challenging due to changes in the production system, increase in scale and intensification of production. Thus, strategies are needed for the environmental sustainability of production systems (KUNZ, 2019).

Keywords: Biogas, Production, Waste.

RESUMO
As cadeias de produção agropecuárias têm se tornado, ao longo dos anos, mais importantes e desafiadoras devido a mudanças no sistema de produção, aumento da escala e intensificação da produção. Dessa forma, são necessárias estratégias para a sustentabilidade ambiental dos sistemas produtivos (KUNZ, 2019).

Palavras-chave: Biogás, Produção, Dejetos.

1 INTRODUCTION

The agricultural production chains have become, over the years, more important and challenging due to changes in the production system, increase in scale and intensification of production. Thus, strategies are needed for the environmental sustainability of production systems (KUNZ, 2019).

The meat industry generates a large amount of animal waste, such waste needs an ecologically correct destination due to its high polluting potential. One of the alternatives is anaerobic digestion, an efficient technology for treating waste, reducing the organic load in addition to producing biogas.

The increase in production is accompanied by an increase in the amount of waste from this productive sector. A solution for waste from fish farming is aquaponics, a technique that integrates fish farming (fish farming) with hydroponics (growing vegetables without the presence of soil), this is a practice of growing vegetables.

In a conventional aquaponics system, the waste is removed from the fish farms to be used in the hydroponic units as nutrients, in this study the waste is retained in a decanter that feeds the biodigester and after the end of the anaerobic digestion process the residue, now biofertilizer, it is mixed with the water that

irrigates the plants. The integrated system provides benefits for both systems, with savings of 90% in water consumption (LIMA et al., 2021)

In this context, the generation of biogas is a sustainable alternative, considering the benefits to the environment, economics, among others (BANERJEE, 2021).

The main advantage of this technology is the generation of renewable energy by degrading organic waste with low nutrient content, using different substrates, in addition to the low cost of the production process, being an alternative to meet future energy needs (KHALID, A. et al 2011).

The inspection in a biodigester must be done frequently, checking temperature, pH, pressure, among other factors that influence the production of biogas. A solution that helps in this inspection are automated systems that in this study are applied in a biodigester that informs in real time the internal conditions, serving as a decision-making system.

2 GOAL

Evaluate whether biogas production from the anaerobic digestion of waste from fish farming in an aquaponics module meets the energy demands of this module.

3 METHODOLOGY

This is a theoretical - practical study, developed from articles published in electronic databases, annals of events, publications on websites of companies specialized in the subject, such as: EMBRAPA, CiBiogás and Google Scholar, using the descriptors: biogas, sustainability , aquaponics and automation, in Portuguese and English. Analyzes and laboratory tests were carried out to characterize the fish waste, and calculate the estimated biogas generation, as well as biochemical methane production tests - PBM to evaluate the digestibility, anaerobic toxicity and potential for methane generation from organic waste. An aquaponics module with an automated biodigester was created to verify the estimated data in the laboratory.

4 DEVELOPMENT

Initially, fish feces were collected for characterization. The fish were placed in incubators and fed twice a day for a period of two weeks. Feces were collected with collection cups installed at the bottom of the incubator.

Next, the characterization of the feces into total, volatile and fixed solids was carried out and a theoretical estimate of the production of biogas was made, as well as the calculation of the volume of the biodigester.

After obtaining the characterization data, the biochemical methane production test - PBM was carried out. This was done in triplicate using different types of substrates, manure, inoculum and manure +inoculum, in order to verify the efficiency of the inoculum and also a prediction of biogas production.

Finally, the aquaponics module was assembled together with the biodigester and automation system. Automation was developed with the following technologies. Arduino microcontroller, Esp32 for wifi connection, pH sensors, temperature pressure and gas detection. To view the data collected by the sensors, an application for mobile devices was developed.

5 FINAL CONSIDERATIONS

Aquaponics alone already contributes to the environment by providing an ecologically correct destination for fish farming. Even so, waste is generated, even if in smaller quantities. Waste from aquaponics proved to be as efficient as the most used in biogas production. The big difference between fish in relation to cattle, pigs and poultry is that they produce a much higher amount of feces than fish, daily. An advantage of fish residues was observed with the analysis of Chemical Oxygen Demand - COD, which presented a much higher result when compared to cattle and pigs. The reason for this difference may be because the residues from psyculture (part of the aquaponics responsible for raising fish) are not just feces, they can contain algae, unconsumed feed and other impurities that may exist in the water and that did not pass through. a process of digestibility like swine and bovine residues resulting from the digestion process.

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