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Bioconversion of *Lemna sp* and Nejayote into Biogas as a starting point for agrowaste

Pabel Cervantes-Avilés [1,*], Valeria Sánchez-Velázquez [1], Janet Gutiérrez-Uribe [1], Germán Cuevas-Rodríguez [2]

[1]Tecnológico de Monterrey, Escuela de Ingenierías y Ciencias, Puebla, México
[2] Universidad de Guanajuato, División de Ingenierías, Campus Guanajuato, Guanajuato, México
*Corresponding Author: pabel.cervantes@tec.mx

GOAL OF THE STUDY

This work shows the research about the recovery of energy via biogas of waste generated in the agroindustry, especially from *Lemna sp* which produced during the treatment of wastewaterof slaughterhouses, and from Nejayote, which is the liquor of the nixtamailization of corn (production of corn flour). The generation of biogas from both agrowastes was studied, determining its energy and economic viability.

METHODOLOGY OF THE INVESTIGATION

From the first stage, the application of an anaerobic digestion for the production of biogas was defined, with an AMPTS II light equipment, and with two sample substrates: *Lemna sp* and Nejayote. Which were obtained according to *Figure 1*. Subsequently, the recommended characterization was carried out following the Mexican regulations for water analysis (*Figure 2*).

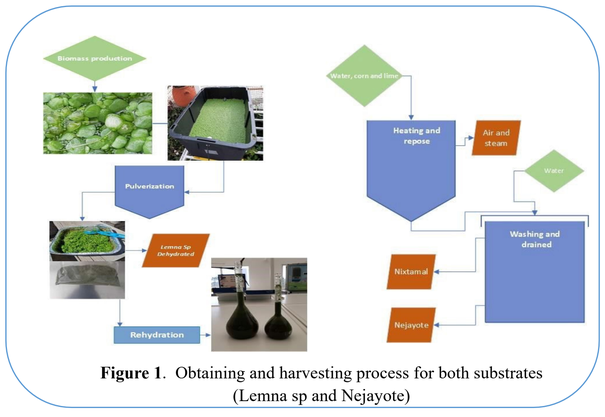

Figure 1. Obtaining and harvesting process for both substrates (Lemna sp and Nejayote)

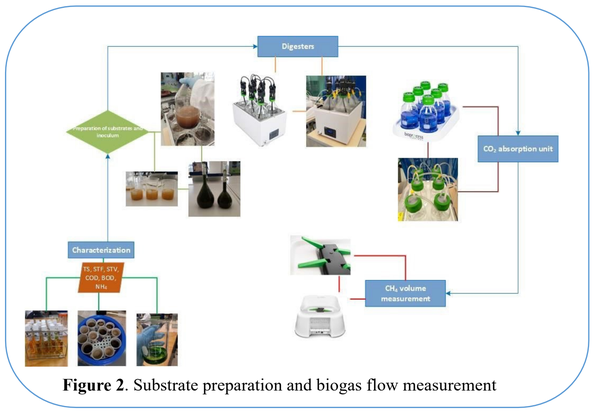

Figure 2. Substrate preparation and biogas flow measurement

The anaerobic digestion process was carried out for 120 hours (5 days). This was done with an amount of 3.42 gr of COD from substrates and 0.61 gr of COD from inoculum in each of the digesters. Thanks to the equipment used, the digesters were held at a temperature of 36°C with an agitation of 10 minutes per hour.

RESULTS AND DISCUSSION

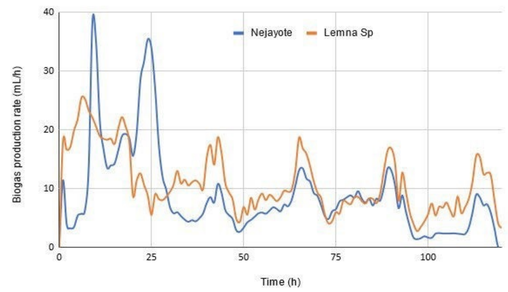

Figure 3. Production flows for both substrates after 120 hours of biodigestion

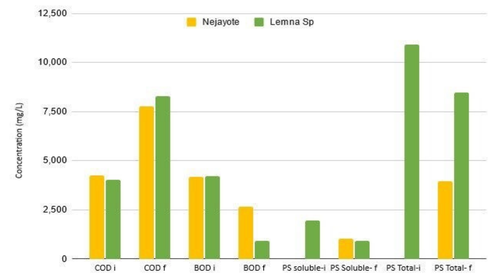

Figure 4. Physicochemical characterization based on COD, BOD and polysaccharides

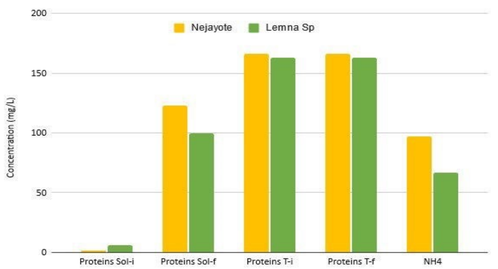

Figure 5. Physicochemical characterization based on proteins and ammonium

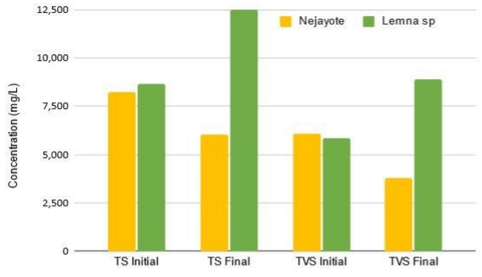

Figure 6. Physicochemical characterization based on solids

- The *Lemna Sp* substrate presented a higher production rate over time compared to Nejayote (Figure 3)

Table 1. Physicochemical characterization of pH and conductivity before and after digestion.

Substrate	pH initial	pH f	Cond i (mS/cm)	Cond f (mS/cm)
Nejayote	8.03	7.37	5.57	5.72
Lemna Sp	7.72	7.70	6.77	7.92

- For the *Lemna Sp* substrate, the decrease in BOD confirms a greater degradation and production of biogas. (Figure 4).
- The higher presence of polysaccharides (PS) in the substrate of *Lemna Sp* indicates a higher yield for the generation of biogas (Figure 4).
- In both substrates, the appearance of soluble proteins is observed, indicating a decay phase (Figure 4).
- Nejayote substrate was disturbed by the appearance of soluble (sol) proteins , total (T) and ammonia, reducing its biogas production (Figure 5).

Table 2. Quantitative analysis of both substrates according to the digestion results

Substrate	Yield of methane production per gram of COD	% of comparison
Standard	350	100
Nejayote	312	-11
Lemna sp	**462**	**32**

- The greater disappearance of TS in Nejayote indicates a better treatment of effluents and the possibility of degradation through an aerobic process. (Figure 6).
- The increase in TS in the *Lemna Sp* bioreactor indicates an increase within the anaerobic consortium (methanogenic bacteria) (Figure 6).

CONCLUSIONS

Lemna sp substrate had a higher performance showing 32% more yield of biogas production thn standard (Table 2). We can state that this performance translates into a cost of $0.926 MXN per kilogram of COD, which later becomes an amount of $6,440.00 pesos per kWh in a day at the domestic rate. Concluding that this production process represents a high saving or sales opportunity for future applications in the electrical sector.

ACKNOWLEDGMENT

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