9th International Interdisciplinary Congress on Renewable Energies, Industrial Maintenance, Mechatronics and Informatics

Booklets

RENIECYT

Registro Nacional de Instituciones y Empresas Científicas y Tecnológicas

1702902 CONAHCYT

RENIECYT - LATINDEX - Research Gate - DULCINEA - CLASE - Sudoc - HISPANA - SHERPA UNIVERSIA - Google Scholar DOI - REDIB - Mendeley - DIALNET - ROAD - ORCID - V|LEX

Title: Xerophilic bioethanol: A modern alternative for biofuel production

Authors: Lugo-Palacios, Oscar, Pérez-García, Laura Andrea, Alvarez-Macías, Carlos and Varela-Moreno, Rubén Ociel

ROR Facultad de Estudios Superiores Cuautitlán KUD-8337-2024 0009-0006-5363-6688 2055417

ROR Facultad de Estudios Superiores Cuautitlán HPF-4026-2023 0000-0002-5880-6192 887623

ROR Facultad de Estudios Superiores Cuautitlán H-3977-2017 0000-0002-2263-0316 165872

ROR Facultad de Estudios Superiores Cuautitlán LBI-6063-2024 0009-0003-1502-2085 1335433

Editorial label ECORFAN: 607-8695

BCIERMMI Control Number: 2024-01

BCIERMMI Classification (2024): 241024-0001

RNA: 03-2010-032610115700-14

Pages: 10

CONAHCYT classification:

Area: Biology, Chemistry, and Life Sciences

Field: Life sciences

Discipline: Biotechnology

Subdiscipline: Other

ECORFAN-México, S.C.

Park Pedregal Business. 3580, Anillo Perif., San Jerónimo Aculco, Álvaro Obregón, 01900 Ciudad de México, CDMX,

Phone: +52 1 55 6159 2296

Skype: ecorfan-mexico.s.c.

E-mail: contacto@ecorfan.org

Facebook: ECORFAN-México S. C.

Twitter: @EcorfanC

www.ecorfan.org

Holdings

Mexico, Colombia, Guatemala, Bolivia, Cameroon, Democratic Republic of Congo, Spain, El Salvador, Ecuador, Taiwan, Peru, Paraguay, Nicaragua

PRESENTATION CONTENT

INTRODUCTION

Climate change is the most pressing challenge of our era. Its consequences threaten key sectors such as agriculture, tourism, biodiversity and human health, among others (Hernández, 2020). Therefore, reorienting efforts is inevitable in the energy and transportation industry, and in view of the aforementioned, several alternatives to generate energy in a sustainable manner are emerging.

Bioethanol production involves the transformation of biomass through thermochemical or biochemical processes to generate a fermentable substrate for biofuel production (Amaris et al., 2015).

In response to the demand for bioethanol and the multidisciplinary global problem, second generation bioethanol production from xerophytic plants has emerged (Estrada-Maya et al., 2022). These plants have characteristics that make them resilient to droughts and high temperatures (Granados-Sánchez et al., 1998). These plants grow in arid and semi-arid regions (de Almeida, 2019).

Figura 1. Plantas xerófitas (Ortega, 2019 ; Semerel et al.,2023)

- Hernández, Y. (2020). Cambio climático: causas y consecuencias. *Renovat: Revista de Estudios Interdisciplinarios en Ciencias Sociales, Tecnología e Innovación*, *4*(1), 38-53.
- Amaris, J. M., Manrique, D. A., & Jaramillo, J. E. (2015). Biocombustibles líquidos en Colombia y su impacto en motores de combustión interna. Una revisión.
- Estrada-Maya, A., & Weber, B. (2022). Biogás y bioetanol a partir de bagazo de agave sometido a explosión de vapor e hidrólisis enzimática. *Ingeniería, investigación y tecnología*, *23*(2).
- Granados-Sánchez, D., López-Ríos, G. F., & Gama-Flores, J. L. (1998). Adaptaciones y estrategias de las plantas de zonas áridas. *Revista Chapingo Serie Ciencias Forestales y del ambiente*, *4*(1), 169-178.
- de Almeida, I. V. B., Souza, J. T. A., & Batista, M. C. (2019). Melhoramento genético de plantas forrageiras xerófilas: Revisão. *Pubvet*, *13*, 153.
- Ortega, Z., Castellano, J., Suárez, L., Paz, R., Díaz, N., Benítez, A. N., & Marrero, M. D. (2019). Characterization of Agave americana L. plant as potential source of fibres for composites obtaining. *SN Applied Sciences*, *1*, 1-9.
- Semerel, J., John, N., Dehaen, W., & Fardim, P. (2023). Valorization of Aloe barbadensis Miller.(Aloe vera) Processing Waste. *Journal of Renewable Materials*, *11*(3).

METHODOLOGY

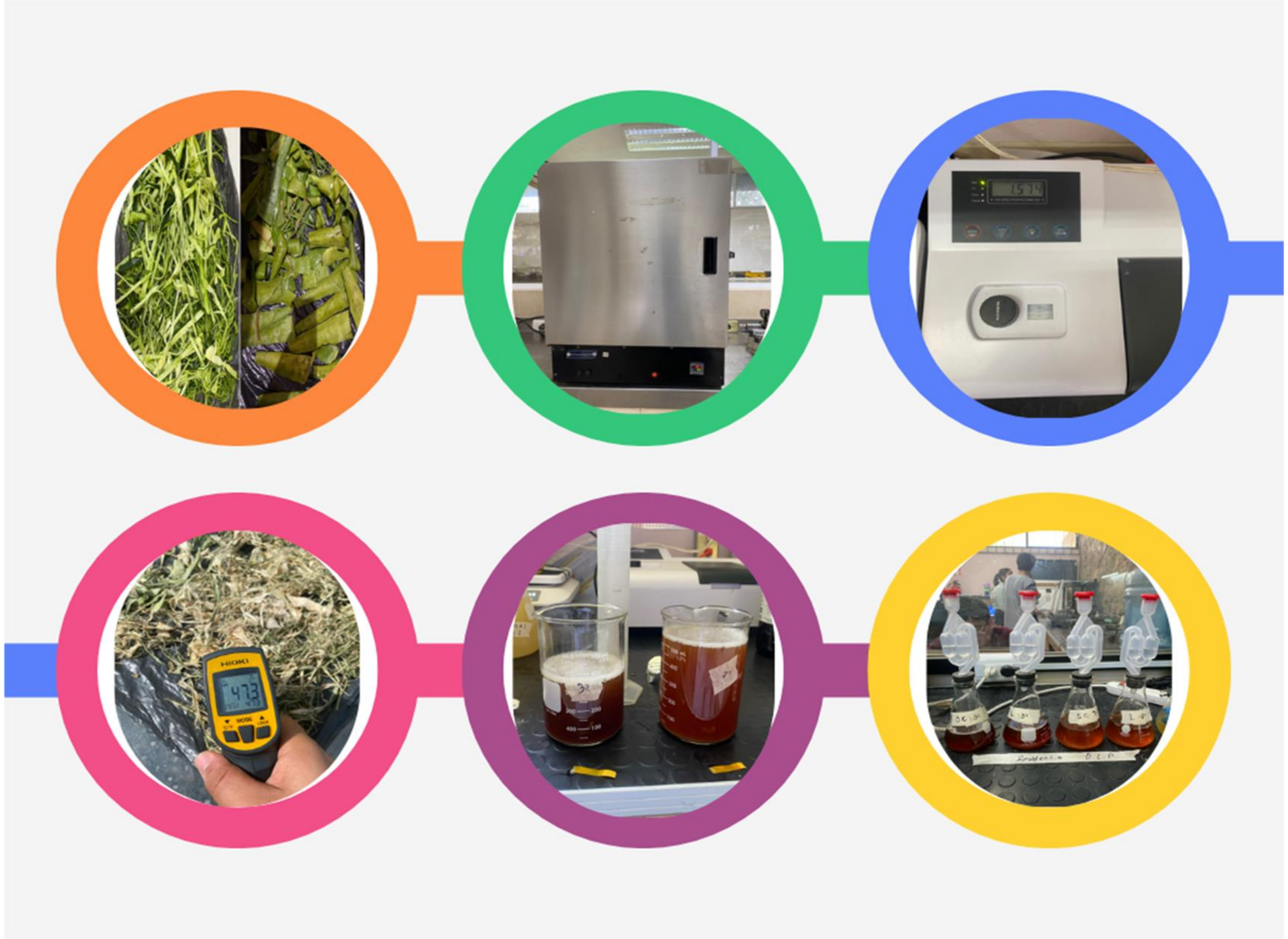

Figure 2. Process diagram

RESULTS

Table 1. Biomass characterization results

BIOMASS CHARACTERIZATION DATA			
BIOMASS	DENSITY (kg/m^3)	MOISTURE (%)	ASH (%)
Aloe barbadensis Miller	965	73.645	1.472
Agave americana	990	76.49	1.628

RESULTS

Culture media with *Lalvin EC-1118* and *Saccharomyces cerevisiae*.

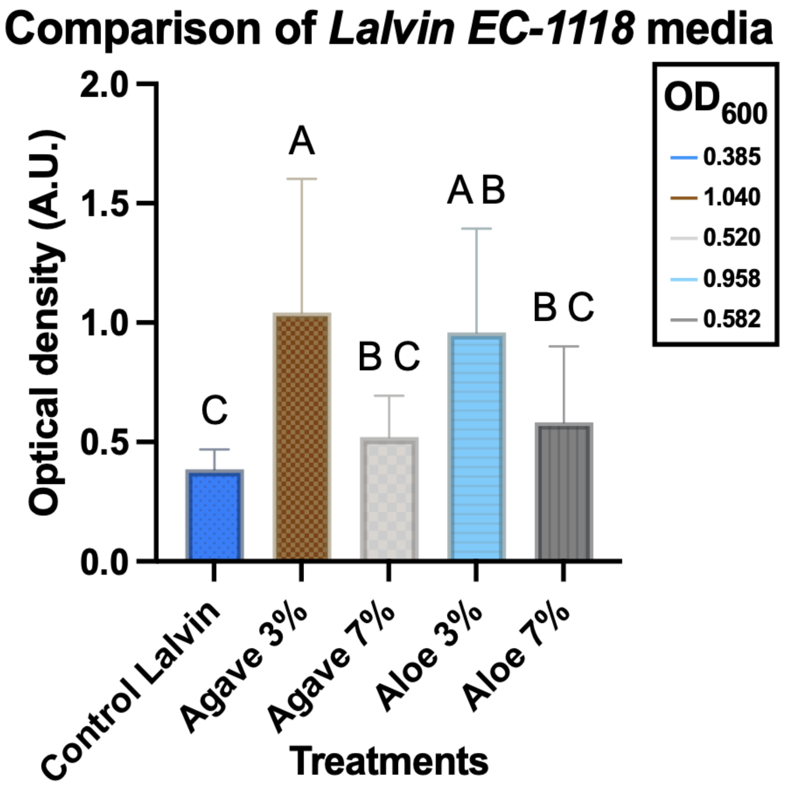

Figure 3. *Lalvin EC-1118* media ANOVA by random columns 95%

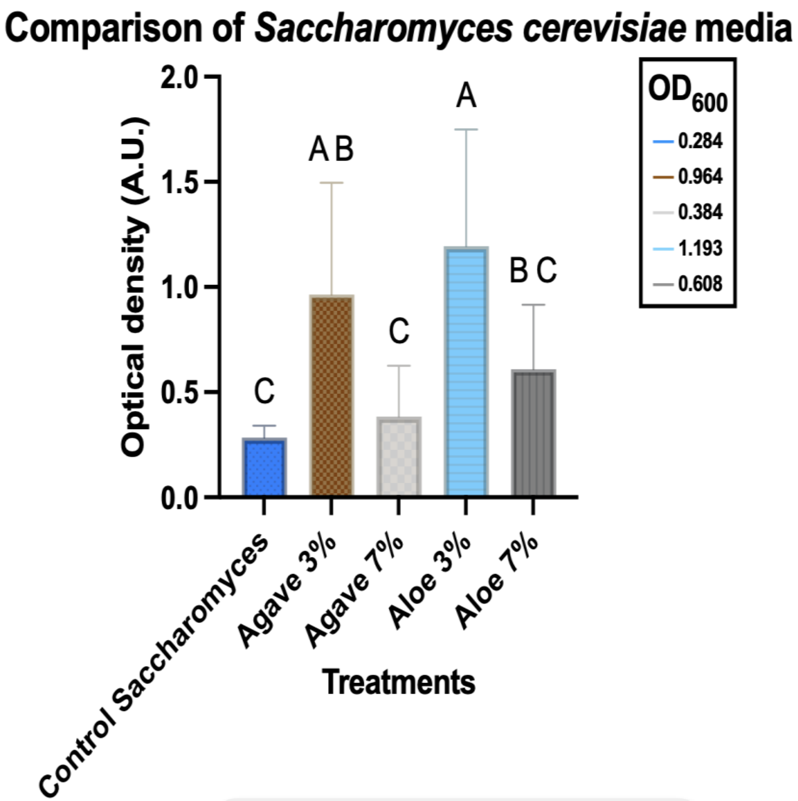

Figure 4. *Saccharomyces cerevisiae* media ANOVA by random columns 95%

RESULTS

Comparison of total yeast growth and sugar consumption of the 8 hydrolysates.

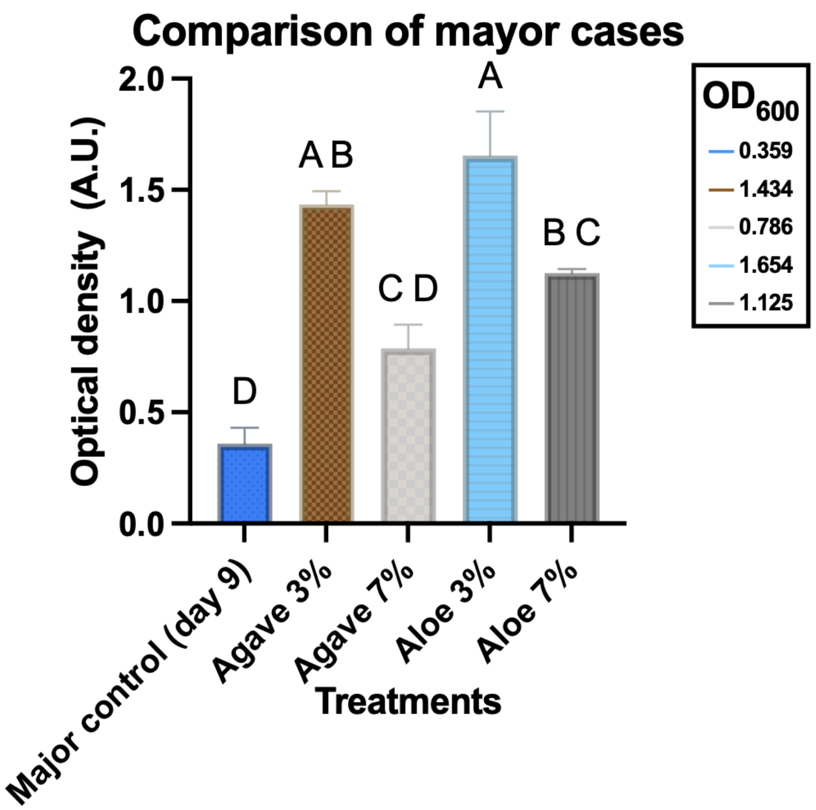

Figure 5. *Comparison of percentages*

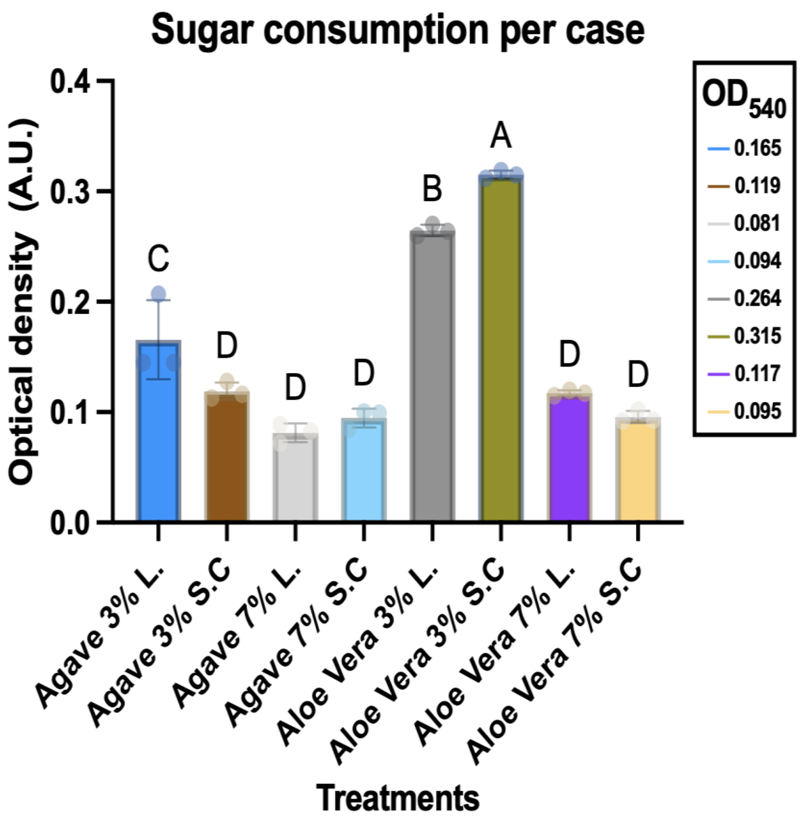

Figure 6. *Sugar consumption*

RESULTS

Relationship between growth and sugars consumed.

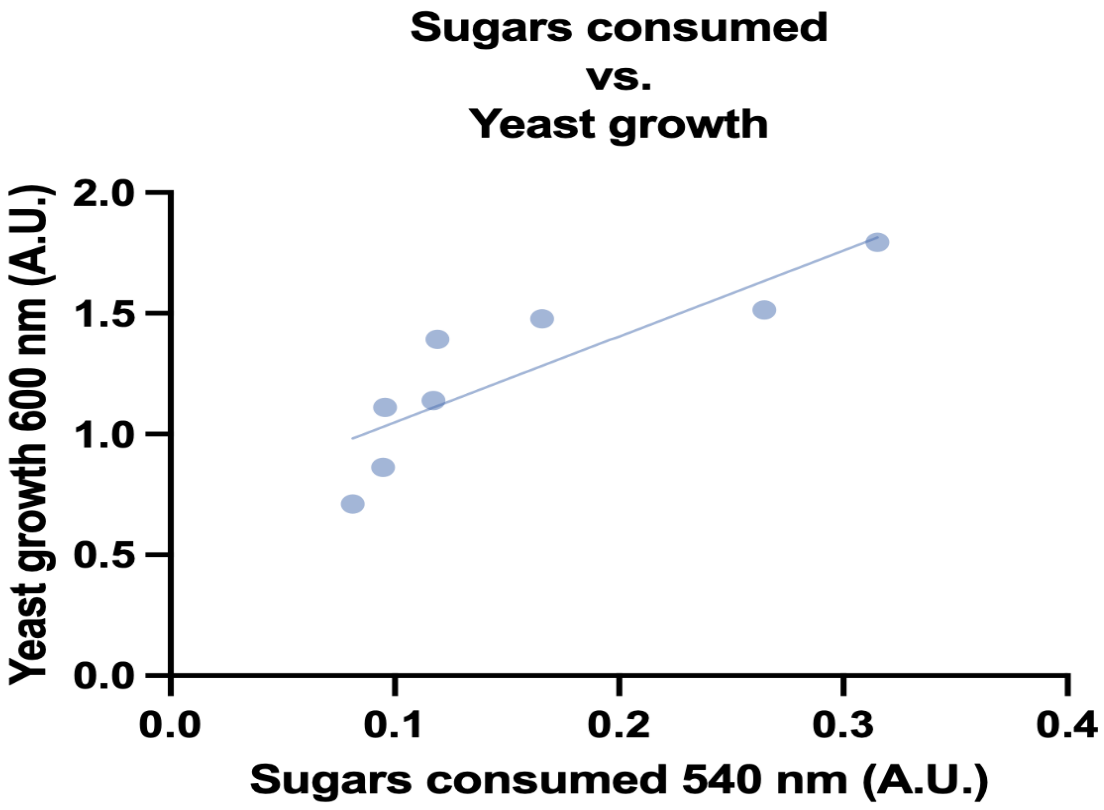

Figure 7. Sugars vs growth, r = 0.86 and p = 0.0062

CONCLUSIONS

Similarities were observed in the physicochemical properties of the biomass from *Agave americana* and *Aloe barbadensis Miller*. However, *Aloe barbadensis Miller* proved to be the most suitable biomass source.

Regarding the yeasts, *Lalvin EC-1118* showed greater efficiency with the hydrolysates of *Agave americana*, while *Saccharomyces cerevisiae* performed better with *Aloe barbadensis Miller*.

The 3% hydrolysates were the most suitable for yeast growth, while higher concentrations (7%) showed lower sugar availability, possibly indicating excessive hydrolysis.

The consumption of reducing sugars and yeast growth indicated favorable fermentation, showing a direct consumption-growth relationship.

The most optimal case for bioethanol production was *Aloe barbadensis Miller* at 3% with the presence of Saccharomyces cerevisiae yeast.

The correlation obtained was positive and significant between yeast growth and sugar consumption, giving a value for $r = 0.86$ and $p = 0.0062$, concluding that both are directly proportional.

The authors thank the Instituto Tecnológico de La Laguna for providing the facilities at the time of using the laboratory for the research carried out.

Thanks to the academic staff of PRODEP, ITLAG-CA-10, TecNM and CONAHCyT projects.

REFERENCES

Antecedents.

Alejandra, R. A. M., & Elizabeth, C. G. A. (2023). Obtención de Fructooligosacáridos de Agave y su Potencial Biológico: Un Artículo de Revisión. *Ciencia Latina Revista Científica Multidisciplinar*, *7*(2), 11710-11734.

Antury, K. L. A., Rojas, D. A. V., & Bermeo, O. M. B. (2021). Conservación de las propiedades nutraceúticas del Aloe Vera (Aloe Barbadensis Miller), mediante técnicas de secado. *Ingeniería y Región*, (25), 6-21.

Cunha, J. T., Soares, P. O., Baptista, S. L., Costa, C. E., & Domingues, L. (2020). Engineered Saccharomyces cerevisiae for lignocellulosic valorization: a review and perspectives on bioethanol production. *Bioengineered*, *11*(1), 883-903.

Basics.

Amaris, J. M., Manrique, D. A., & Jaramillo, J. E. (2015). Biocombustibles líquidos en Colombia y su impacto en motores de combustión interna. Una revisión.

de Almeida, I. V. B., Souza, J. T. A., & Batista, M. C. (2019). Melhoramento genético de plantas forrageiras xerófilas: Revisão. *Pubvet*, *13*, 153.

Estrada-Maya, A., & Weber, B. (2022). Biogás y bioetanol a partir de bagazo de agave sometido a explosión de vapor e hidrólisis enzimática. *Ingeniería, investigación y tecnología*, *23*(2).

Granados-Sánchez, D., López-Ríos, G. F., & Gama-Flores, J. L. (1998). Adaptaciones y estrategias de las plantas de zonas áridas. *Revista Chapingo Serie Ciencias Forestales y del ambiente*, *4*(1), 169-178.

Hashmi, M., Khan, T. K., Khan, W., Hasan, F., Hameed, A., Khan, S., ... & Shah, A. A. (2018). Comparison between a newly isolated yeast strain and lalvin EC-1118 for enhanced ethanol yield from sugarcane molasses employing batch and modified fed-batch fermentation. *Journal of Biobased Materials and Bioenergy*, *12*(1), 134-142.

Hernández, Y. (2020). Cambio climático: causas y consecuencias. *Renovat: Revista de Estudios Interdisciplinarios en Ciencias Sociales, Tecnología e Innovación*, *4*(1), 38-53.

Ortega, Z., Castellano, J., Suárez, L., Paz, R., Díaz, N., Benítez, A. N., & Marrero, M. D. (2019). Characterization of Agave americana L. plant as potential source of fibres for composites obtaining. *SN Applied Sciences*, *1*, 1-9.

Semerel, J., John, N., Dehaen, W., & Fardim, P. (2023). Valorization of Aloe barbadensis Miller.(Aloe vera) Processing Waste. *Journal of Renewable Materials*, *11*(3).

Supports.

Li, H., Foston, M. B., Kumar, R., Samuel, R., Gao, X., Hu, F., ... & Wyman, C. E. (2012). Chemical composition and characterization of cellulose for Agave as a fast-growing, drought-tolerant biofuels feedstock. *RSC advances*, *2*(11), 4951-4958.

Montañez, L. J. B. (2020). Cuantificación de azúcares reductores del sustrato en residuos de piña con el método del ácido 3, 5-dinitrosalicílico. *Revista de Investigación*, *13*(1), 57-66.

Ortega Quintana, F. A., Alvarez, H., & Botero Castro, H. A. (2017). Enfrentando el modelado de bioprocesos: una revisión de las metodologías de modelado. *Revista ION*, *30*(1), 73-90.

Rajeswari, G., & Jacob, S. (2020). Deciphering the aloe vera leaf rind as potent feedstock for bioethanol through enzymatic delignification and its enhanced saccharification. *Industrial Crops and Products*, *143*, 111876.

ECORFAN®