

## **Bioenergy and Biorefinery potential of residues: A representative case of the Sucre region in Colombia.**

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**Keywords:** Biomass energy potential, Energy production, Biorefineries

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### **Abstract.**

The existence and availability of residues in the world have been dramatically increasing last years as the population and demand for goods and food also increased. Different works committed to characterize organic residue generation and potentially show interesting facts to be considered the main raw material for bioenergy and biorefineries soon. This biomass can produce direct or indirect energy through different pathways. Direct energy production involves the conversion of biomass into electric power from heat and other primary sources (i.e. synthesis gas) through thermochemical processes such as combustion, gasification, and pyrolysis (Solarte-Toro et al., 2021). On the other hand, indirect energy production considers biomass conversion in platforms (i.e. sugars) and then, to other energy sources such as ethanol, butanol, biogas, hydrogen, and others. Fermentation is the most used technology to produce bioethanol that involves different pretreatment schemes to obtain fermentable sugars and downstream configurations to produce fuel-grade ethanol (99.5%). Biorefineries include or not bioenergy production together with food, feed, chemicals, and materials production in an integrated and smart way (Cardona Alzate et al., 2019).

To demonstrate the potential of any residue to produce bioenergy or other products in a biorefinery approach, it is necessary to start from their composition and then to establish as a minimum (base case) the energy potential experimentally (for example, LHV or HHV) or according to accurate prediction models (Shen et al., 2010). Then the composition should undergo a platform and biorefineries analysis proposed by Ortiz-Sanchez et al., (Ortiz-Sanchez & Cardona Alzate, 2022).

Colombia is one of the world's most per capita biomass producers (Piedrahita-Rodríguez et al., 2022). The high availability of sun and water in the country and the high agriculture and agribusiness share in the country's economy explain this fact. The regions in the country close to the Caribbean sea are even more productive in terms of residues, and the logistics to manage these residues are easier, given the convenient topography and access to ports and highways connecting the country. The Sucre province in the north of Colombia represents this region, providing huge quantities of rice, cassava, maize, wheat, plantain, avocado, and other fruit and vegetables. This region is used as a base case in Colombia and methodologically to analyze the potential of residues for the energy of biorefinery purposes.

In the present work the strategy for this analysis is presented and applied based on experimental data regarding the HHV and the residues (10) characterization in the lab. Then based on the literature and calculations the bioenergy potential of these residues the results in terms of energy efficiency are discussed and compared to the overall biorefinery potential based on the platforms analysis algorithm. As a conclusion, for the Colombian case based on Sucre region it was demonstrated that not all the residues as expected have the potential mainly of biorefineries. Half of the cases (5) demonstrated that only bioenergy is the best way or non bioenergy non biorefineries are not prefeasible.

It is validated and explained with current use of these residues in the country. The methodology was validated for analyzing preliminary the potential of residues to be used just in Bioenergy or integral Biorefinery applications.

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