frontiers in Energy Research

EDITORIAL
published: 30 March 2021
doi: 10.3389/fenrg.2021.675042

Editorial: New Insights Into the Valorization of Agricultural and Agroindustrial Byproducts Through Biorefinery Cascade Processing

María del Mar Contreras[1,2]*, *Keikhosro Karimi*[3], *Amani Taamalli*[4] and *Eulogio Castro*[1,2]

[1] Department of Chemical, Environmental and Materials Engineering, University of Jaén, Jaén, Spain, [2] Centre for Advanced Studies in Earth Sciences, Energy and Environment (CEACTEMA), University of Jaén, Jaén, Spain, [3] Department of Chemical Engineering, Isfahan University of Technology, Isfahan, Iran, [4] Department of Chemistry, College of Sciences, University of Hafr Al Batin, Hafr Al Batin, Saudi Arabia

Keywords: biomass, food wastes, biochemicals, fermentation, biorefinery and agro-industrial byproducts

Editorial on the Research Topic

New Insights Into the Valorization of Agricultural and Agroindustrial Byproducts Through Biorefinery Cascade Processing

OPEN ACCESS

Edited by:
Hu Li,
Guizhou University, China

Reviewed by:
Ping Zhu,
Technical University of Denmark, Denmark

****Correspondence:***
María del Mar Contreras
mcgamez@ujaen.es

Specialty section:
This article was submitted to Bioenergy and Biofuels, a section of the journal Frontiers in Energy Research

Received: *02 March 2021*
Accepted: *08 March 2021*
Published: *30 March 2021*

Citation:
Contreras MdM, Karimi K, Taamalli A and Castro E (2021) Editorial: New Insights Into the Valorization of Agricultural and Agroindustrial Byproducts Through Biorefinery Cascade Processing. Front. Energy Res. 9:675042. doi: 10.3389/fenrg.2021.675042

Currently, there is a growing interest in the exploitation of agri-food wastes that enables the sustainable energy transition, the reduction of CO_2 and other greenhouse gases emissions, and at the same time, the production of bioproducts with industrial interest. It is one of the keys for moving from a linear economy toward a circular bioeconomy, while their use does not compete with food security. In fact, it can be a bridge between the dichotomy of food vs. fuel (Lyytimäki et al., 2021), but a deal is the recalcitrant nature of these lignocellulosic wastes that need to be modified for valorization generally using strong pretreatments (Contreras et al., 2020). For that reason, we edited this Research Topic *New Insights into the Valorization of Agricultural and Agroindustrial Byproducts Through Biorefinery Cascade Processing*, with the idea of serving as a platform for novel research that aimed to propose biorefinery cascades mainly based on agri-food wastes (**Figure 1**). As Food and Agriculture Organization of the United Nations (FAO) states, the power of bioscience and biotechnology can harness a bioeconomy to deal *with the different challenges for a growing population while preserving our natural resources* (Food Agriculture Organization of the United Nations, 2021).

In this Research Topic, four articles were published, leading with different new strategies to exploit agri-food resources to recover sugars and lignin and to produce biofuels like bioethanol and biohydrogen. One novel strategy based on F_2O process was proposed by Li et al. mimicking the natural white-rote fungi degradation process of switchgrass biomass. A two-step pretreatment was applied using: formic acid, which can be recycled, together with the catalysis of the Fenton reaction, and the use of dioxane as an organic solvent for further fractionation. It maximized the sugar release from switchgrass biomass and promoting the lignin processing by *Rhodococcus opacus*, a microorganism able to accumulate lipids. Thus, this strategy provided a new path for improving the lignin and carbohydrate processability in next generation biorefineries (Li et al.). Moreover, as an example of biofuels production, two studies have been published; one of them was performed at lab scale and the other using simulation approaches. The former explored the generation of biohydrogen from the organic fraction of waste diapers after optimization using response surface methodology. At the optimal conditions (43 g C/g N, 12% solid loading, and 31°C), it enabled to obtain 2.48 mmol H_2/g, which is comparable to those values obtained with other types of wastes

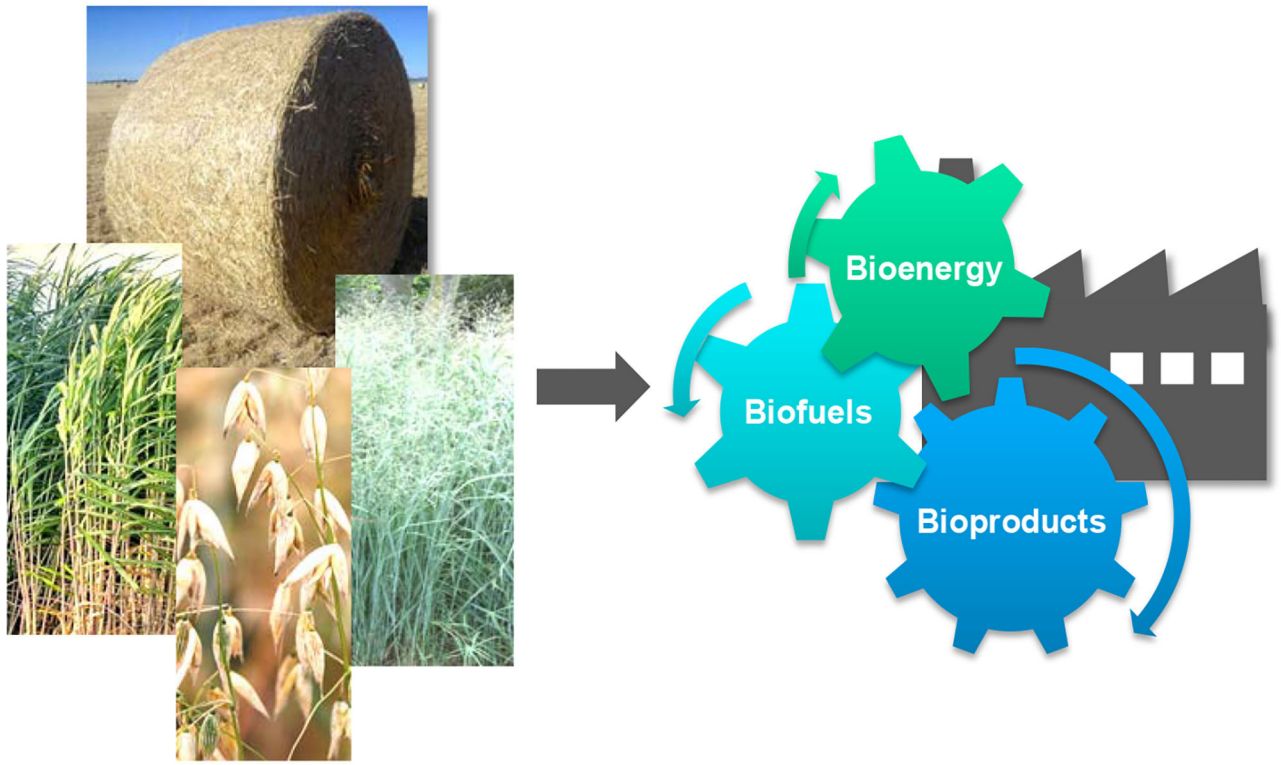

FIGURE 1 | Valorization cascade of agricultural and agroindustrial resources. Some pictures were used from https://pixabay.com/.

(Sotelo-Navarro and Poggi-Varaldo). In the second paper, the techno-economic study of bioethanol production from sugarcane as a gasoline oxygenate agent was performed. Compared to exporting, it represents a higher gross netback of 308.3 USD/ton of sugarcane vs. 222.5 USD/ton of sugarcane (Aburto and Martínez-Hernández). Therefore, this can also be a way to obtain first-generation ethanol without compromising food security. In addition, both studies suggest that the organic fraction of waste diapers and sugarcane surplus have a great potential as a feedstock to produce biofuels in biogas and sugars-derived biorefineries, respectively.

Finally, as a strategy to reduce CH_4 emissions by the livestock sector, Ábrego-García et al. evaluated the effects of the supplementation of fermented oat straw as a carrier of lovastatin, an inhibitor of methanogenic microorganisms, on *in vitro* ruminal methanogenesis. The consumption of <20% of fermented oat straw (i.e., a lovastatin concentration of around 100 and 150 mg L^{-1} in the ruminal fermentation medium) achieved up to 38% of CH_4 reduction, without changes in the chemical composition and nutritional value of the diet (Ábrego-García et al.). This valorization way can be carried out together with other strategies in a multi-product biorefinery looking for a sustainable management of the livestock sector and to produce bioenergy, biofuels, and/or other bioproducts from oat straw.

In summary, we are pleased to present this Research Topic that presents four different strategies applied to valorize different agri-food resources, which offers new opportunities to move into a more sustainable industry with zero-waste formation. However, further work is required to pass from the lab or simulation scale to the industrial scale.

AUTHOR CONTRIBUTIONS

MC: conception and draft writing. KK and AT: manuscript revision. EC: funding acquisition and manuscript revision. All authors contributed to the article and approved the submitted version.

ACKNOWLEDGMENTS

The authors are grateful for the FEDER UJA project 1260905 funded by Programa Operativo FEDER 2014–2020 and Consejería de Economía y Conocimiento de la Junta de Andalucía (Spain).

REFERENCES

Contreras, M. d. M., Romero, I., Moya, M., and Castro, E. (2020). Olive-derived biomass as a renewable source of value-added products. *Process Biochem.* 97, 43–56. doi: 10.1016/j.procbio.2020.06.013

Food and Agriculture Organization of the United Nations (2021). *Sustainable and Circular Bioeconomy for Food Systems Transformation*. Available online at: http://www.fao.org/in-action/sustainable-and-circular-bioeconomy/en/ (accessed February 23, 2021).

Lyytimäki, J., Assmuth, T., Paloniemi, R., Pyysiäinen, J., Rantala, S., Rikkonen, P., et al. (2021). Two sides of biogas: Review of ten dichotomous argumentation lines of sustainable energy systems. *Renew. Sustain. Energy Rev.* 141:110769. doi: 10.1016/j.rser.2021.110769

Conflict of Interest: The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.