Recovery of waste products from the oil extraction process (BECOMOLI)

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http://www.agricolaalbi.es/wp-content/uploads/2018/09/ajuts.pdf

01. Rationale

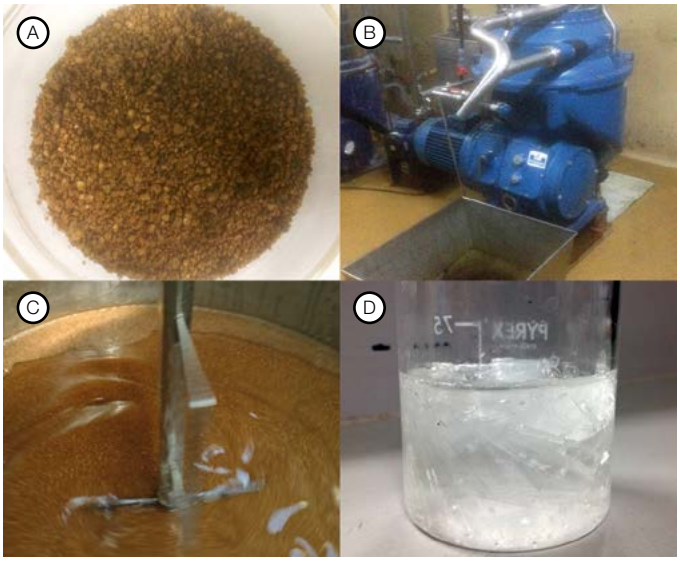
Agrícola de l'Albi is dedicated to the production of olive oil. The oil extraction yield is 23%. The remaining mass is a residue called pomace, which is sold to companies as biomass. Given the significant volume of pomace generated, which is a common problem for the sector, the project has implemented alternative processes in the oil mill that generate value-added by-products such as glucose and polyphenols. The innovation introduced by this project is that it focuses on the application of cascade biorefinery processes to recover higher value products from the complex biomass resulting from olive oil production, which will lead to an improvement in the economic performance of the mill and increase the sustainability of the process.

The main objective of the project was to find how to exploit and recover the pomace, applying eco-efficient cascade methods to recover the glucose and polyphenolic compounds it contains, in order to open up new market niches and improve competitiveness, providing an alternative to the current problem faced by olive oil producers, namely the high volume of waste by-products that are generated and which are generally sold as biomass. Glucose and polyphenolic compounds can be marketed to biotechnological industries. The processes used must allow the end products to be classed as natural products with a low carbon footprint.

Thus, the technical objectives of the project were:
1. To determine the influence of crop production technologies, harvesting time and mill processing parameters on the chemical characteristics and yields of the end products recovered from the pomace.
2. To fractionate the pomace using eutectic solvents.
3. To obtain glucose and polyphenolic acids from the celluloses and lignins recovered from the pomace.
4. To scale up the processes in the oil mill.

02. Results and conclusions

The conclusions that can be drawn as a result of this project are:
1. Pomace samples from different types of crops do not differ from each other in terms of chemical composition and can therefore be considered to be the same.
2. For the extraction of lignin, the highest yields are obtained with the 72% sulphuric acid treatment, although the lignin obtained is very dark and less pure than that obtained using ionic liquid; furthermore, the use of this method requires reactors and equipment that can withstand this type of aggressive treatment.
3. NaOH treatment results in the residue with the highest percentage of cellulose enrichment.
4. The optimal conditions for extracting lignin using the ionic liquid were: 4 h, 120°C and a water content of between 5% and 20%.
5. In terms of lignin "purity", and according to FT-IR characterisation, the order of purity would be as follows: ionic liquid > sulphuric acid > alkaline, since the shape and area of the peak at 1510 cm^{-1} for the ionic liquid treatment is larger and more Gaussian than the rest. The lignin obtained with the alkaline treatment contains a cellulose coprecipitate, as it has several very intense features at the frequencies of 890 and 1150 cm^{-1}.
6. As for the residue, the fractions obtained that are richest in polysaccharides susceptible to saccharification follow the order: alkaline ≥ ionic liquid > sulphuric acid. The alkaline treatment has a high capacity to dissolve the biomass, leaving the cellulose practically unaltered and with a moderate percentage of lignin. On the other hand, with the sulphuric acid treatment, the cellulose is hydrolysed and therefore a solid fraction rich in glucose is not obtained.
7. A sequential combination of acid (ionic liquid) and alkaline treatments does not help to increase lignin yields, but it does give a cellulose enrichment of more than 60%.
8. With regard to the tests on the saccharification of CRF from pomace, the best performing cellulase was from *Aspergillus* sp. with a 64% glucose content yield in the final solution.
9. Using CMC as a reference material may lead to some confusion when comparing different cellulases, as the activity could vary when using a different type of substrate.
10. Finally, we can say that the first scale-up to 20 g performed in the laboratory has been totally satisfactory, even improving the performance with respect to the milligram-scale samples used to fine-tune the method. The scaling to 9 kg was also performed in the company, showing that the available reactor was suitable for the corresponding extraction with these quantities of pomace. Unfortunately, the final yields could not be calculated from the initial 9 kg of pomace, as they were lost while loading the centrifuge and could therefore only be estimated from the 5 L of recovered ionic liquid.



A: Recovered raw cellulose. B: Centrifugation to separate stone and ionic liquid. C: Ionic liquid and stone. D: Ionic liquid. Photos: Operational Group.

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