Microwave-assisted $FeCl_3$-catalysed hydrolysis of giant reed and cardoon cellulose followed by fermentation to single cell oil by *Lipomyces starkeyi*

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The transition from a fossil-based economy to a bio-based one is a current global goal. Thus, the replacement of fossil fuels and materials with biofuels and bioproducts is a key solution. Biorefining of biomass, containing cellulose and hemicellulose, generates hexose and pentose sugars which can be converted into several final added-value bioproducts. Among biofuels, biodiesel is one of the most promising renewable energy sources since it does not require new technology and engines for its use. Traditional biodiesel is produced on the industrial scale starting from vegetable oils obtained from oleaginous crops. However, most of the oleaginous plant species are food crops, determining the ethical debate on the right use of these renewable resources and the competition between the energy industry and food chain. An innovative and promising solution is represented by new generation biodiesel, produced from microbial oil or single cell oil (SCO) using the hydrolysates obtained from non-edible biomasses as carbon source for the growth of oleaginous yeasts [1].

The present study investigated the sustainable microwave-assisted $FeCl_3$-catalysed hydrolysis of giant reed (*Arundo donax* L.) and cardoon (*Cynara cardunculus* L.) cellulose to give glucose [2]. The acid pretreatment was implemented for giant reed [2], while steam-explosion pretreatment was adopted for cardoon. Giant reed is a promising energy crops able to grow on marginal lands [2], while cardoon stalks are the crop residue in the production of vegetable oil [3]. The homogeneous catalyst $FeCl_3$ presents important advantages compared with traditional strong homogeneous inorganic acids, such as less corrosion of reactor, low cost, simple recovery by precipitation, good efficacy at mild reaction conditions, energy saving, and high selectivity [2]. Under different reactions conditions for the two feedstocks, each glucose-rich hydrolysate was obtained, which was employed as fermentation medium for the production of SCO by the yeast *Lipomyces starkeyi* DSM 70296. For giant reed, the low production of furanic compounds enabled the fermentation of undetoxified hydrolysates, while for cardoon the furfural removal was necessary before the fermentation step. After hydrolysis, for both hydrolysates the fermentation provided good lipid yields (~14 wt%) and oil content (~25 wt%). The SCO appears a valid candidate for the production of new generation biodiesel with good oxidative stability and cold flow properties. Moreover, it resulted very similar to palm and rapeseed oils, usually employed as a renewable source for the production of traditional biodiesel.

[1] Di Fidio, N., Dragoni, F., Antonetti, C., De Bari, I., Raspolli Galletti, A.M., Ragaglini, G. **2020**. *Bioresource Technology* 315, 123790-123798.

[2] Di Fidio, N., Fulignati, S., De Bari, I., Antonetti, C., Raspolli Galletti, A. M. **2020**. *Bioresource Technology* 313, 123650-123658.

[3] Barbanera, M., Castellini, M., Tasselli, G., Turchetti, B., Cotana, F., Buzzini, P. **2021**. *Fuel* 283, 118967-118976.