ETHYLIC BIODIESEL PRODUCTION USING INTRA AND EXTRACELLULAR LIPASES FROM THERMOPHILIC FUNGI

Roberto da Silva
Institute of Biosciences, Literature and Exact Sciences / São Paulo State University (UNESP)

Figure 1. Growth of Thermomucor indicae seudaticae N31 on loofah sponges analyzed by light optical microscope.
(A) Sponges without fungi; (B) and (C) whole cells immobilized in LS; 1. Loofah cell walls appear in dark gray (larger cells) and 2. hyphae of the fungus T. indicae-seudaticae N31 appear in light gray (smaller cells) (Ferrarezi et al. 2014)

Figure 2. Experimental set-up for enzymatic biodiesel production with ultrasound: (1) immobilized enzyme, (2) immobilizes mycelium, (3) ultrasound probe, (4) power supply, (5) thermostated vessel, (6) reaction vessel, (7) solvent, (8) water inlet/outlet, (9) stirring equipment, (10) Product of reaction after reaction time and removal of glycerol phase (Borges, 2012)

The proposed project aimed to study the use of lipases produced by thermophilic fungi on ethyllic biodiesel production. The enzyme lipolytic and transesterification ability were valued in its free form and immobilized in polymeric supports and in immobilized fungal mycelia. Lipases were characterized according to specific reactions and its kinetic characteristics. Besides hydrated ethanol, others such as soybean oil, castor oil and animal fat were used as raw materials to produce biodiesel. The solid state fermentation (SSF) for enzyme production were investigated in constructed bioreactors (bench/pilot). Investigations were also conducted aiming the effect of ultrasound irradiation in the transesterification reaction in the production of biodiesel. The final product were characterized by GC-MS, thermogravimetry, calorimetry, and standards methods for biodiesel.
SUMMARY OF RESULTS TO DATE AND PERSPECTIVES

This study aimed at selecting fungal strains capable of producing lipolytic enzymes with transesterification property to be used for the production of biodiesel via ethylic transesterification. The ability of transesterification of enzymes was evaluated in both free, immobilized on supports and also, immobilized in its own hyphae. The results obtained so far are presented below. Several strains of fungi with esterifying activity and positive for the synthesis of biodiesel were isolated and some fungi have been identified which include: *Thermomucor indicae-seudatica*, *Rhizomucor pusillus*, *Myceliophthora* sp., *Thermomyces lanuginosus*, *Fusarium verticilloide*, *Acremonium* sp., *Aspergillus* sp. and *Thermomyces* sp. Some lipases have already been characterized for specificity and kinetics. Oils from different botanical sources have been used as feedstock for biodiesel production. Different lipases were immobilized in different supports (Quilles et al. 2015), and some had their hyphae immobilized on their own culture medium as *R. pusillus* and *Thermomucor indicae-seudatica* (Ferrarezi et al. 2014). The enzyme from *Rhizomucor pusillus* was also immobilized (Ferrarezi et al. 2013), and showed 80 and 70% respectively in yield in the conversion of substrates into esters. The analyzes of the esters were confirmed by gas chromatography. A solid state fermentation (SSF) bench bioreactor was constructed and successfully operated for lipase production by the fungus *Myceliophthora* spp (Casciatori et al. 2013). Investigation was also conducted on the effect of ultrasound irradiation in the transesterification reaction in the production of biodiesel from soybean oil and ethanol using the immobilized enzyme from *Thermomyces lanuginosus* and *Acremonium* sp (Borges 2012; Ohe 2011). The results showed that the temperature of 30 to 35 °C and 5% of enzyme were the optimum conditions for the catalysis. The highest conversion values were observed with soy oil. The irradiation of ultrasound (10%) led to an increased conversion of ethyl esters from 92 to 99%, showing a positive effect on the production of biodiesel by the enzymes.

MAIN PUBLICATIONS


