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# Enzymatic saccharification of solid residue of olive mill in a batch reactor

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**Abstract**

This paper describes the enzymatic hydrolysis of solid residue of olive mill (OMRS) in a batch reactor with the *Trichoderma reesei* enzyme. Before enzymatic saccharification, crude lignocellulosic material is submitted to alkaline pre-treatment with NaOH. Optimum conditions of the pre-treatment (temperature of $T$=100°C and OMRS–NaOH concentration ratio of about $R$=20) were determined. The optimum enzymatic conditions determined were as follows: pH of about 5, temperature of $T$ 50°C and enzyme to mass substrate mass ratio $E/S$ 0.1 g enzyme (g OMRS)$^{-1}$. The maximum saccharification yield obtained at optimum experimental conditions was about 50%. The experimental results agree with Lineweaver Burk's formula for low substrate concentrations. At substrate concentrations greater than 40 g dm$^{-3}$, inhibitory effects were encountered. The kinetic constants obtained for the batch reactor were $K_m$ = 0.1g dm$^{-3}$ min$^{-1}$ and $V_m$ = 800 g dm$^{-3}$. © 2000 Elsevier Science S.A. All rights reserved.

*Keywords:* Olive mill; Enzyme bioreactors; Saccharification; Batch processing; Optimisation; Product inhibition

## 1. Introduction

Olive mill wastes are a by-product of olive oil manufacture which cause environmental pollution. Work on the treatment and valorization of these wastes has been conducted over the last decade. Olive mill wastewaters (OMWW), because of their low content in nitrogenous organic components and richness in carbon sources, offer a highly favourable environment for the growth of dinitrogen-fixing micro-organisms which provide for the biotransformation of OMWW into an agrobiological product [1]. OMWW have been also used as a substrate for high yield production of extracellular polysaccharides [2]. Production of the microalgae *Chorella pyrenoidosa* and *Scenedesmas obliquas* was realized by using OMWW as a nutrient medium [3].

Considerable research has also been conducted during this past decade on the new possibilities offered by enzymes in lignocellulosic material valorization and or treatment. The literature concerning this research directed towards developing enzymatic systems for solid wastes has been extensively reviewed recently [4]. Enzymatic saccharification of different lignocellulosic materials has been utilized to product sugar and other products [5–8]. Before the development of enzymatic saccharification, the various crude lignocellulosic materials were pre-treated to render them more accessible to saccharification, resulting in an increase in sugar production [9–13].

The purpose of this study was to optimize the enzymatic saccharification of olive mill solid residue (OMRS) after pre-treatment with sodium hydroxide and hydrolyzation in the presence of a commercial cellulase: *Trichoderma reesei*.

## 2. Materials and methods

### 2.1. Enzyme and substrate

A commercial enzyme *T. Reesei* with a fungal origin (Sigma, France) was used. The enzyme has a reported activity of 5.08 units mg$^{-1}$ (one unit will liberate 1 μmole of glucose from cellulose in 1 h at pH 5 and $T$ 37°C). Enzyme solutions with concentrations ranging from 0.5–6 g dm$^{-3}$ were made with an acetic acid/sodium acetate buffer solution (0.05 M and pH 5).

The substrate was olive mill solid residue which had been collected over 3 years (1995–1998) from the Tadmait (Kabylia region) olive oil plant and which was transported to the laboratory at 4°C. Although the olive mill residue

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