

Growth characteristics of *Aspergillus* sp. grown on spent sulphite liquor

WA Pretorius* and GG Lempert

Department of Chemical and Environmental Engineering, University of Pretoria, Pretoria 0002, South Africa

Abstract

The growth characteristics of *Aspergillus* sp. when grown on spent sulphite liquors (SSL), were determined. Maximum sustainable growth occurs at temperatures < 50°C with near optimum growth at temperatures < 45°C. No growth occurs at pH < 4,5 with an optimum pH between 5,5 and 6. The biodegradable fraction of SSL with a monoculture of *Aspergillus* sp. was 33,6%. The growth kinetic constants of *Aspergillus* sp. when grown on diluted SSL at 45°C were:

$$\begin{array}{lcl} \mu_{\max} & = & 0,318 \text{ h}^{-1}; \\ b & = & 0,016 \text{ h}^{-1} \end{array} \quad \text{and} \quad \begin{array}{lcl} K_s & = & 260 \text{ mgCOD l}^{-1}; \\ Y & = & 0,7 \text{ gbiomass-(gCOD)}^{-1}. \end{array}$$

The crude protein contents and amino acid profile of *Aspergillus* sp. are given.

Introduction

In selecting micro-organisms suitable for single-cell protein (SCP) production from spent sulphite liquor (SSL) at 45°C, *Aspergillus* sp., most probably *A. fumigatus*, was the dominating species (Pretorius and Lempert, 1993). *A. fumigatus*, a very commonly occurring fungus, is easily identifiable and inhabits most places on earth. It is also an opportunistic pathogen and the most important causal agent of systemic mycosis. The infectious phase is mainly conidiospores and the sites of attack are usually the lungs and the respiratory tract (Domsch et al., 1980).

If the intention is to mass-cultivate *A. fumigatus* for SCP purposes, it would be important to know its growth characteristics and whether or not conidiospore formation generally occurs during continuous cultivation.

In this paper some factors that could affect the mass cultivation of *Aspergillus* sp. as well as its amino acid composition as a potential SCP source are examined.

Materials and methods

Reactor configuration and substrate

The experimental reactor set-up and diluted SSL substrate used was as described elsewhere (Pretorius and Lempert, 1993).

Evaluation of temperature and pH effects on the growth rate of *Aspergillus* sp.

To evaluate the effects of temperature and pH on the growth rate of *Aspergillus* sp., the general operating conditions were fixed: Substrate COD concentration at 10 g-l⁻¹; hydraulic residence time (T) at 3 h and cell residence time (θ_c) at 9 h.

As a reference point the reactor was operated at a temperature of 45°C and a pH of 5,5. Once steady state growth was obtained the test parameter was stepwise increased (or decreased) as shown in Table 1.

The temperature and pH were maintained at any particular set point with the thermostat and pH-stat respectively. To lower the pH, 5N H₂SO₄ was used and to increase the pH, 5N NaOH was used.

After each step change the reactor was operated for three cell residence times to ensure steady state conditions.

Determination of the biodegradable fraction of SSL

The method of Grady and Lim (1980) was used to determine the inert and biodegradable fractions of SSL. A 15 l temperature-controlled (45°C) and aerated batch reactor filled with diluted SSL substrate at pH 5,5 was inoculated with a pure culture of *Aspergillus* sp. Two hundred and fifty vat samples were taken at 2 h intervals for the 48 h duration of the experiment. Compensation for evaporation was made with distilled water. The samples were filtered and analysed for COD.

Determination of kinetic constants of *Aspergillus* sp. grown on SSL

To determine the kinetic constants, T was fixed between 2,5 and 3,3 h, pH at 5,5 and temperature at 45°C. θ_c was varied from 18 h (where dissolved oxygen was limiting) till the biomass was wasted faster than growth (washout). Three cell residence times were allowed between consecutive step changes. The results were analysed by the methods proposed by Grady and Lim (1980).

Analytical methods

Flow rates: The volumes of feed used and effluent and biomass produced were collected for each cell residence period and from these the respective flow and biomass harvesting rates were calculated. COD analyses were done on the feed and filtered effluents and the suspended solids were determined according to *Standard Methods* (1985).

Protein content: Washed, freeze-dried biomass (cultivated at θ_c = 9 h, T = 3 h, T = 45°C and pH = 5,5) was used for protein analysis. Crude protein was determined in duplicate by the micro-Kjeldahl method (Horwitz, 1975) and the amino acid profile on acid digested samples analysed on a Beckman 121 M

*To whom all correspondence should be addressed.

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