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Short Communication

Mixed-culture polyhydroxyalkanoate production from olive oil mill pomace

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HIGHLIGHTS

- PHA was produced in non-sterile conditions using olive pomace as the only feedstock.
- Buffer addition to olive pomace increased organic acid production by 75%.
- Highest volumetric productivity was 0.042 g PHA/L-day.
- Highest PHA conversion yield 0.3625 g PHA/L fermentate.
- Maximum %PHA was 39% (on a dry weight cell basis).

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ABSTRACT

Polyhydroxyalkanoate (PHA) was produced in bench-scale sequencing batch reactors (SBRs) fed olive pomace fermentate containing a mixed microbial consortium. Initial anaerobic fermentation in a sequencing batch fermentor (SBF) produced soluble carbon compounds, mainly organic acids. SBF effluent was centrifuged, removing solids, and fed into a SBR where intracellular PHA was produced. Buffer pre-treatment of diluted olive pomace increased organic acid production 75% in SBF fermentate over no pre-treatment. Hydraulic retention time (HRT), solids retention time (SRT), pomace concentration/dilution, and aerobic operation vs. anoxic/oxic cycling were studied to improve PHA formation. Maximum %PHA achieved was 39% (on a dry-weight cell basis), and the highest volumetric productivity was 0.042 g PHA/L-day under fully aerobic conditions. The highest PHA conversion yield was 0.3625 g PHA/L fermentate.

1. Introduction

The goal of this study was to identify operating parameters that maximized conversion of olive pomace, an olive oil production byproduct, to polyhydroxyalkanoates (PHA). Olive pomace currently has limited use and often incurs significant cost associated with disposal. Bacterially produced PHA seems an attractive replacement for petroleum-derived plastic, owing to its biodegradability and ability to be produced from a variety of carbon sources without requiring toxic chemicals.

Current commercial PHA production practices are based on aseptic, single-strain bacterial fermentations that generally rely on refined carbon feedstocks (Khanna, 2004). Investigations of industrial waste products such as whey protein for carbon and nutrient sources have yielded modest cost savings, but considerable energy and cost are expended to maintain sterility (Akaraonye et al., 2010). Mixed bacterial cultures and non-sterile processing methods and feedstocks could allow PHA bio-plastic to compete economically with petroleum-derived plastics.

The proposed process consists of an initial olive pomace fermentation in a sequencing batch fermentor (SBF) to produce soluble organic acids. Centrifuged decant from the SBF, referred to as olive pomace fermentate, is then fed into a sequencing batch reactor (SBR), where organic acids and other compounds are consumed and significant quantities of intracellular PHA are produced. This study's objectives were to (1) evaluate pre-treatment options for increasing organic acid production in SBFs; (2) identify SBF operating parameters that maximize organic acid production; and (3) ascertain SBR operating parameters that maximize PHA production.

2. Methods

2.1. Feedstock materials and microorganisms

2.1.1. Olive pomace

Fresh olive pomace, consisting of olive organic matter and crushed pits, containing 66% moisture content, was stored

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