Bioresource Technology 114 (2012) 281–286

Contents lists available at SciVerse ScienceDirect

Bioresource Technology

journal homepage: www.elsevier.com/locate/biortech

Biogas productivity by co-digesting Taihu blue algae with corn straw as an external carbon source

Weizhang Zhong, Zhongzhi Zhang *, Yijing Luo, Wei Qiao, Meng Xiao, Min Zhang

State Key Laboratory of Heavy Oil Processing, College of Chemical Engineering, China University of Petroleum, Beijing 102249, PR China

ARTICLE INFO

Article history:
Received 17 November 2011
Received in revised form 22 February 2012
Accepted 24 February 2012
Available online 10 March 2012

Keywords:
Anaerobic co-digestion
Biogas production
Taihu blue algae
Corn straw
C/N ratio

ABSTRACT

A batch anaerobic test was conducted to evaluate the effects of adding high carbon content of corn straw to the digestion of Taihu blue algae to attain an optimal C/N ratio for higher methane yield. The addition of corn straw in algae at a C/N ratio of 20/1 increased methane yield by 61.69% at 325 mL g^{-1} VS^{-1} (compared with 201 mL g^{-1} VS^{-1} of algae digestion alone), followed by C/N ratios of 16/1 and 25/1, all operated at 20 g VS L^{-1} and 35 °C. The results suggest the optimal C/N ratio for co-digestion of algae with corn straw is 20/1. The findings could offer options for efficient methane production and waste treatment.

1. Introduction

The bloom of cyanobacteria is a ubiquitous phenomenon in eutrophic lakes, reservoirs, and polluted water in many countries of the world. Over the past few years, several lakes in China, such as Chaohu Lake, Taihu Lake, and Dianchi Lake, among others, have experienced increasingly massive cyanobacterial blooms (Qin, 2009). The excessive growth of cyanobacteria in lakes damages the natural functions of the lakes and threatens the safety of the drinking water supply. For example, Taihu Lake, the third largest lake in China and which provides drinking water for more than 2 million people, caused serious toxicity problems because on an algal bloom during the summer of 2007 (Guo, 2007).

The treatment of algal bloom in large lakes is a worldwide problem. To reduce the eutrophication of Taihu Lake, refloatation of blue algae after blooming was considered to be the most efficient approach to retrieve nitrogen and phosphorus from the lake. In 2007, collecting algae played a key role in controlling Taihu Lake algal bloom. However, algae collected could amount to thousands of tons every day. Without further management, large amounts of skimmed blue algae will result in serious secondary environmental pollution. Anaerobic digestion, coupled with energy production in the form of biogas and waste treatment, has been employed for the treatment of several different kinds of organic wastes. Previous researchers demonstrated that biogas production from skimmed algae can be more practical compared with other recovery methods, such as incineration, composting, and so on (Yan et al., 2010; Zeng et al., 2010).

Anaerobic digestion is a spontaneous process, wherein anaerobic microorganisms decompose organic matter and produce biogas primarily containing methane and carbon dioxide. The process does not require advanced dewatering or further chemical extraction. It not only reduces organic pollution but also provides a new source of energy. Several hundred thousand tons of algal waste may be skimmed annually from Taihu Lake alone, and such large amounts of algae could be a potential substrate for biogas production. Golueke et al. (1957) published the first study on anaerobic digestion of microalgae (*Scenedesmus* spp. and *Chlorella* spp.). Since then, a large number of research projects have been carried out. Early research efforts peaked in the late 1970s and early 1980s as a consequence of the first oil crisis. Species under investigation include several macroalgae such as *Laminaria* spp., *Macrocystis* spp. (Chynoweth et al., 1993), marine alga *Gracilaria ceae* (Wise et al., 1979), and green marine alga *Ulva* spp. (Bruhn et al., 2011). The microalgae reported as feedstocks for anaerobic digestion include *Scenedesmus* spp. (Yen and Brune, 2007), *Spirulina* spp. (Samson and Leduy, 1982; Samson and Leduy, 1986), *Euglena* spp., *Chlorella vulgaris* (Ras et al., 2011), *Melosira* spp., and *Oscillatoria* spp. (Uziel, 1978). Although research on Taihu blue algae as substrates for biogas production is very limited (Yuan et al., 2011; Zeng et al., 2010), recent theoretical calculations (Sialve et al., 2009) have indicated their potential. From these studies, it can be concluded that algae are good feedstocks for anaerobic digestion, because of its high conversion rates and efficiencies.

* Corresponding author. Tel.: +86 10 89734284; fax: +86 10 89733974.
E-mail address: bjzhwz@hotmail.com (Z. Zhang).

0960-8524/$ - see front matter © 2012 Elsevier Ltd. All rights reserved.
http://dx.doi.org/10.1016/j.biortech.2012.02.111