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Production and characterization of a bioflocculant produced by *Aspergillus flavus*

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HIGHLIGHTS

- Cation-independent bioflocculant produced by *Aspergillus flavus*.
- Sucrose and peptone are the most favorable sources for bioflocculant production.
- The bioflocculant mainly consists of polysaccharide and protein with a molecular weight of 2.57×10^4 Da.
- The bioflocculant is stable at wide ranges of pH and temperature.

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ABSTRACT

The production and characterization of a bioflocculant, IH-7, by *Aspergillus flavus* was investigated. About 0.4 g of purified bioflocculant with an average molecular weight of 2.574×10^4 Da could be obtained from 1 L of fermentation medium. The bioflocculant mainly consisted of protein (28.5%) and sugar (69.7%), including 40% of neutral sugar, 2.48% of uronic acid and 1.8% amino sugar. The neutral sugar components are sucrose, lactose, glucose, xylose, galactose, mannose and fructose at a molar ratio of 2.4:4.4:4.1:5.8:9.9:0.8:3.1. Fourier-transform infrared spectroscopy analysis revealed that purified IH-7 contained hydroxyl, amide, carboxyl and methoxyl groups. The elemental analysis of purified IH-7 showed that the weight fractions of the elements C, H, O, N and S were 29.9%, 4.8%, 34.7%, 3.3%, and 2.0%, respectively. IH-7 had good flocculating rate in kaolin suspension without cation addition and stable over wide range of pH and temperature.

1. Introduction

Flocculants are useful agents in the aggregation of colloids, cells and suspended solids and are commonly used for drinking water production, waste water treatment, fermentation processes, and food production (Shih et al., 2001). These flocculants are usually classified into three groups: (1) inorganic flocculants such as polyaluminum chloride, (2) organic synthetic flocculants such as polyacrylaminde derivatives and (3) naturally occurring flocculants such as chitosan. Inorganic and organic synthetic flocculants are widely used in industrial fields because of their cost effectiveness and efficiency, although their use may incur some environmental and health problems (Liu et al., 2009). In contrast, bioflocculants, extracellular biopolymeric substances secreted by bacteria, fungi, algae and yeast (Salehizadeh and Shojaosadati, 2001) are biodegradable and nontoxic flocculants (Dermlim et al., 1999).

Bioflocculants are mainly composed of macromolecular substances, such as polysaccharide and protein (Lu et al., 2005; Zheng et al., 2008). The composition and properties of bioflocculants depend on type of bioflocculant-producing microorganisms (BPMs), composition of media and environmental conditions. The differences in the composition and properties of polysaccharides and proteins lead to differences in the charge of bioflocculant (Bala Subramanian et al., 2010). The flocculation ability of bioflocculants produced by *Vagococcus* sp. (Gao et al., 2006), *Halomonas* sp. (He et al., 2010), *Bacillus circulans* (Li et al., 2009a), *Pseudoalteromonas* sp. (Li et al., 2008), *Serratia ficaria* (Gong et al., 2008), *Bacillus licheniformis* (Li et al., 2009b), and *Klebsiella mobilis* (Wang et al., 2007) depends on the presence of cations. Ca^{2+} is known to link negatively charge groups on flocculants and particles (He et al., 2010). Addition of cations to the flocculation process can produce secondary pollution and increase costs. Thus, finding cation-independent bioflocculants is desirable.

In the present study, the production of a bioflocculant, IH-7, produced by *Aspergillus flavus*, was investigated to determine optimal culture medium composition and environmental conditions. Various factors influencing the production of IH-7, like carbon source, nitrogen source, C/N ratio, initial pH of culture medium,

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