Technical note

Control of *Microcystis aeruginosa* TH01109 with batangas mandarin skin and dwarf banana peel

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Abstract

We studied the inhibitory effects of batangas mandarin skin and dwarf banana peel on *Microcystis aeruginosa*. In laboratory assays, algal growth was significantly inhibited by the addition of mandarin skin extract (0.1% w/v). When the concentration of mandarin skin increased to 0.5% (w/v), no algal growth was detected, whereas in the presence of banana peel extract (0.5%, w/v) the algal biomass was only slightly suppressed. The results show that mandarin skin has higher anti-algal activity than banana peel. Fresh unprocessed mandarin skin and banana peel showed very effective anti-algal activity. Pre-treatment was not required for their anti-algal activity. It is possible that mandarin skin and banana peel might be effective material to control harmful algal blooms.

Keywords: anti-algal activity, batangas mandarin skin, dwarf banana peel, inhibitors, *Microcystis aeruginosa*, algal bloom

Introduction

The occurrence of harmful algal blooms in eutrophic water bodies is a worldwide problem. The production and release of a range of cyanotoxins is often associated with algal blooms (Codd et al., 1989; Codd, 1995). Of the toxic cyanobacterial genera, *Microcystis* is the most common and cosmopolitan genus. The most commonly reported cyanotoxins are hepatotoxins, the largest group being heptapeptides, known as microcystins. Via many exposure routes these toxins present human and animal health hazards (Turner et al., 1990; Bell and Codd, 1994; Falconer, 1996, 1997; Frazic et al., 1998). The deaths of more than 50 haemodialysis patients in Brazil have been attributed to exposure to microcystins in dialysis water (Jochimsen et al., 1998; Pouria et al., 1998). In China, it has become evident over recent times that the number of reports of toxic algal blooms in potable waters has increased. However, the mechanical removal of algal scum is energy and time consuming, and thus impractical. Also, the chemical treatment is undesirable in potable water supplies (Ball et al., 2001). Therefore, environmentally sound, economically favourable and effective methods are required to remove these harmful algae.

Decomposed barley straw has been reported to have algal-inhibiting properties (Welch et al., 1990). A number of other material have also been found to be anti-algal such as brown-rotted wood (Pillinger et al., 1995) and some leaf litters, in particular oak leaves (Ridge et al., 1995). The use of both barley straw and leaf litters to control algal growth depends on the inhibitors that they generate during aerobic decomposition in water (Gibson et al., 1990; Ridge et al., 1995). These inhibitors are derived from oxidised polyphenolics, which originate mainly from lignin (Pillinger et al., 1994, 1995; Ridge and Pillinger, 1996). Although barley straw has been shown to be a useful alternative to physical or chemical treatment for the prevention of algal blooms (Welch et al., 1990; Barrett et al., 1996; Ridge and Pillinger, 1996), the use of barley straw needs considerable management effort, and the long-term ecological safety of its use is unknown (Ridge et al., 1999). Furthermore, straw bales used to suppress algal growth may interfere with water traffic and fishing, and it is difficult to dispose of useless straw that has ceased to be anti-algal. Further study by Ball et al. (2001) indicated that decomposed barley straw extract also showed anti-algal capability. It seems that this straw extract could solve some of the problems caused by straw bales.

However, Martin and Ridge (1999) reported the different sensitivities of algal species to barley straw inhibitors, so it is possible that some harmful algae might increase if barley straw were used continuously for several years. It might be better to use several different materials at intervals for controlling harmful blooms. This led us to search for more effective and environmentally sound materials to inhibit unwanted algae.

The aim of this study was to investigate algal growth inhibitory effects of batangas mandarin skin and dwarf banana peel, to assess whether these could be novel anti-algal materials and to establish whether the use of mandarin skin or banana peel would prove a reliable and safe measure to control unwanted algae. To our knowledge, this is the first report to study the anti-algal effects of mandarin skin and banana peel.

Materials and methods

Materials

Microcystis aeruginosa TH01109 was originally isolated from Lake Taihu, Wuxi, Jiangsu, China and microscopically identified using the method described by Smith (1920) and Hu (1980). Cultures were maintained in BG-11 medium (Allen and Stanier, 1968).

Batangas mandarin (*Citrus reticulata* Blanco) and dwarf banana (*Musa cavendishii* Lamb) were obtained from Fujian, China. Mandarin skin and banana peel were washed with tap water and distilled water, and then dried in air.

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