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THE RECOVERY OF LIGNOCELLULOSE-DEGRADING ENZYMES FROM SPENT MUSHROOM COMPOST

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Abstract

The recovery of lignocellulose-degrading enzymes from spent mushroom compost was assessed using a variety of physical and chemical treatments. Maximum recoveries of active xylanase activity were detected in extracts from spent compost which had been physically treated by blending. A range of lignocellulose-degrading activities was also recovered from blended compost extracts; peroxidases, the xylan-debranching enzymes acetylesterase and arabinofuranosidase, and the cellulose-degrading activities endoglucanase, cellobiohydrase and β-glucosidase. The compost extract was also shown to be capable of releasing reducing sugars (12 nmol min^{-1} g $compost^{-1}$) from wheat straw. Characterization of the stability of this enzyme activity showed that maximum activity could be detected between pH 7 and 9 and after 1 h incubation at 65°C. The activity and stability of the enzymes suggest a potential role for enzyme cocktails from compost extracts in the biological upgrading of grass lignocelluloses to animal fodder.

Key words: Spent mushroom compost, lignocellulose degradation, enzymatic hydrolysis.

INTRODUCTION

Large-scale commercial mushroom production began earlier this century and has now spread to over 80 countries around the world, with an annual yield of *Agaricus bisporus* in 1982 of 850 000 tonnes (Manning, 1985; Spencer, 1985). Mushroom cultivation involves the pure culture of spawn, composting and pasteurization of the substrate and careful regulation of growing conditions. The raw materials of the compost used for *Agaricus bisporus* production are straw, horse manure, chicken manure and activators.

The purpose of composting is to prepare a substrate which promotes the growth of mushroom mycelia while excluding other microorganisms. This is achieved by manipulating the natural succession of microorganisms present in the raw materials (Fermor *et al.*, 1985). The microbiological process of composting arises due to the combined activities of a succession of mixed microbial populations. During this microbial succession, each type of microbe is suited to one specific condition of short duration and is only active in decomposing one type, or group, of organic matter present (Wong *et al.*, 1990). Aerobic thermophilic bacteria dominate at the start of composting, but their numbers decrease in later stages, and the actinomycete populations increase. The number of thermophilic fungi remain constant throughout (Hayers & Lim, 1979). *Agaricus bisporus* itself contributes to the composting process by producing a wide range of extracellular hydrolytic enzymes capable of degrading the major polymers found in composted wheat straw. Assays of axenic mushroom culture during mycelial colonization and fruit body formation have detected xylanase, cellulase, laccase and protease activities (Wood, 1979).

Following mushroom harvest, spent mushroom compost is likely to contain not only a large and diverse group of microorganisms, but also a wide range of extracellular enzymes active against wheat straw. At present there is considerable interest in upgrading fibrous byproducts from cereal crops for use as animal fodder. Straw digestibility is related to the depolymerization of its structural macromolecules. Enzymic degradation of straw by a consortium of enzymes would result in depolymerization and therefore an increase in the availability of the carbohydrate fraction and in the digestibility (Giovannozzi-Sermanii *et al.*, 1989). This work examined the enzyme activity of extracts from spent mushroom compost and assessed the biotechnological potential of these enzymes.

METHODS

Extraction of enzymes from spent mushroom compost

Spent mushroom compost was obtained from the Layer de la Haye Mushroom Farm, Layer de la Haye, Essex, UK. Samples of the compost (10 g wet

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