FUNGAL BIODEGRADATION OF BISPHENOL A AND BENZOPHENONE

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ABSTRACT

Sixteen fungal strains from our stock culture were tested the ability to degrade endocrine disrupters, bisphenol A and benzophenone. More than 79 % of bisphenol A could degrade by the culture of *Aspergillus oryzae*, *Cheatomium globosum*, *Penicillium janthillum* LM12, and *Rhizopus oryzae, respectively.* Degradation of benzophenone was archived to less than detection limit by the culture of *Cladosporium* sp. DD618, *Geotricum candidum*, and *Rhizopus oryzae*, respectively.

KEYWORDS

Bisphenol, Benzophenone, Bioegradation, Endocrine disrupting chemicals, Fungi,

INTRODUCTION

Bisphenol A and benzophenone have been listed among "chemicals suspected of having endocrine disrupting effects" by the World Wildlife Fund and Japanese Environment agency.

Bisphenol A is widely used in industry and dentistry to make polycarbonate plastics and epoxy resins (Staples et al., 1998) and is one of the most common environmental endocrine disruptors with an oestrogenic activity (Krishnan et al, 1993) and an acute toxicity to aquatic organisms (Alexander et al. 1988).

Benzophenone has been used as an ingredient of pharmaceuticals, insecticides, agricultural chemicals and fragrance in medicine and industry and as an ultraviolet light-absorber in plastic and polymers. Its derivatives are widely used in cosmetic products such as photostabilizers to protect the skin and hair from ultraviolet irradiation. Benzophenone has also weak estrogenic activity as well as bisphenol A (Nakagawa et al. 2000).

There is an increasing interest in the microbial degradation of such endocrine disruptors. The white rot fungi and their enzymes can degrade bisphenol A (Hirano et al. 2000; Tsutsumi et al. 2001) and remove oestrogenic activity. Some gram-negative bacteria and *Streptmyses* sp. strain also reported to degrade bisphenol A (Lobos et al. 1992; Kang et al. 2004).

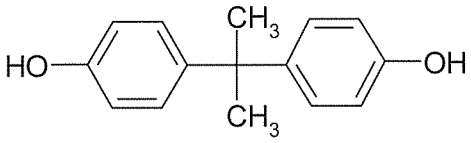
The aim of this study was to identify bisphenol A and benzophenone biodegradability by 16 fungi from our stock culture. A HPLC system was used for analysis of these compounds as the economical methods.

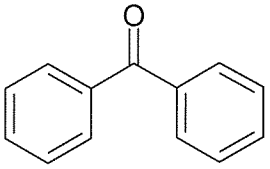
MATERIALS AND METHODS

Chemicals, microorganisms, and culture condition

Bisphenol A and benzophenone (Fig. 1) were purchased from Wako pure chemical (Osaka).Six teen fungal strains from our stock culture were used in this study as listed in Table 1. The medium used for the fungal degradation conteined 4.5 g/l glycerol, 1.0 g/l yeast extract, 0.4 g/l ammonium

sulfate, 0.2 g/l KH_2PO_4, 0.3 g/l K_2HPO_4, and 0.1 g/l $MgSO_4 \cdot 7H_2O$. Initial pH was adjusted to 5.6. The fungal strains were cultivated in a reciprocal shaker at 25°C. Bisphenol A and benzophenone were solubilized in etanol and then added to the medium at final concentration of 15 ppm and 7.5 ppm, respectively.





Bisphenol A Benzophenone

Fig. 1. Chemical structure of bisphenol A and benzophenone

Table 1 List of fungi used for degradation of bisphenol A and benzophenone

Aspergillus niger	*Penicillium roquefortii*
Aspergillus oryzae	*Penicillium* SL413
Chaetomium globosum	*Rhizopus oryzae*
Cladosporium DD618	*Schizophyllum commune*
Cladosporium herbarum	*Scopularriopsis brevicaulis*
Geotrichum candidum	*Sporotrichum cellulophilum*
Mucor javahious	*Trametes hirsuta*
Penicillium janthillum LM12	*Trichoderma viride*

HPLC analysis

After the cultivation at appropriate day, 2 volume of methanol was added to cultured medium and filtrate with a glass filter (GS25, Advantec) to remove insoluble materials and mycelium. Bisphenol A and benzophenone concentration in the filtrate was assayed by HPLC on a Microsorb MV 86 203-C5 reversed phase column (4.6 ID X 25 cm, Rainin, USA) in a Hitachi L6200 apparatus. The solvent system was 50% acetonitrile. The flow rate was 1.0 ml/min and elution was monitored at 279 nm for bisphenol A and 252 nm for benzophenone with Hitachi L4000H UV detector. Concentration of bisphenol A and benzophenone were calculated from peak aria of standard curve. Detection limit by the HPLC was 0.05 ppm for bisphenol A and 0.01 ppm for benzophenone, respectively.

RESULTS AND DISCUSSION

Degradation of bisphenol A

Fungal strains were cultivated in bisphenol A (15 ppm) containing medium for 7 days. More than 80 % of bisphenol A were degraded by the culture of *Aspergillus oryzae* (80.7 % for 7 days), *Cheatomium globosum* (100 % for 6 days), *Penicillium janthillum* LM12 (80 % for 7 days), and *Rhizopus oryzae* (100 % for 5 days) as shown in Fig. 2.

Degradation of benzophenone

Sixteen fungal strains were cultivated in the medium containing 15 ppm of benzophenone at 25°C for 7 days. Three strains, *Cladosporium* sp. DD618 (5 days), *Geotricum candidum* (6 days), and *Rhizopus oryza*e (3 days) could degrade efficiently benzophenone to below detection limit. Time course for benzophenone degradation of the three strains are shown in Fig. 3.

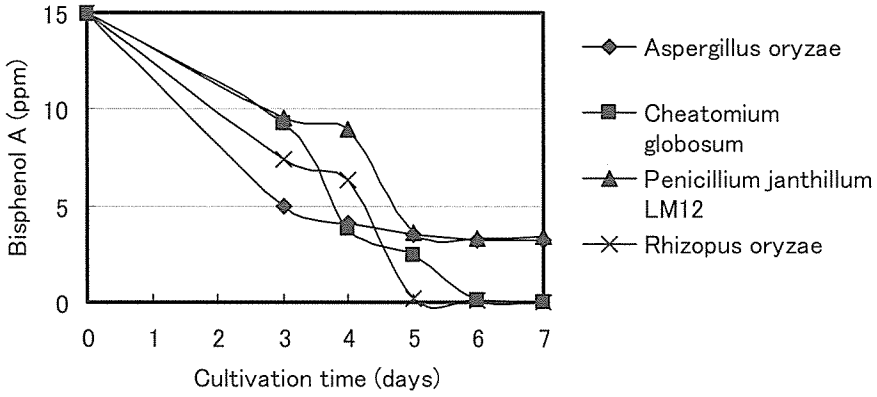


Fig. 2 Time course of bisphenol A degradation by fungi

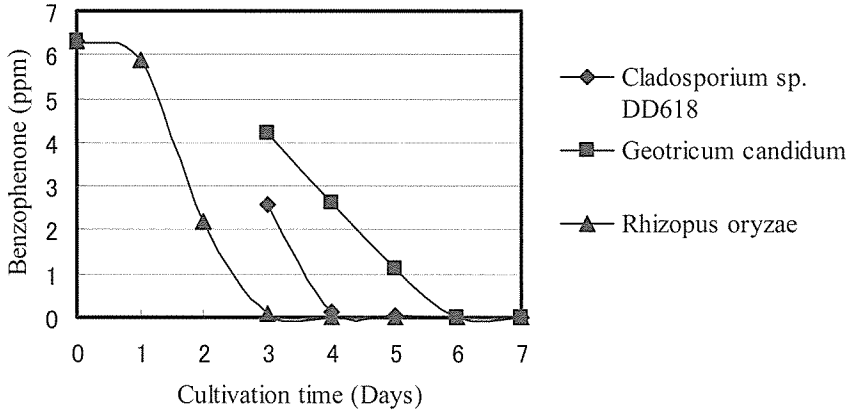


Fig. 3 Time course of benzophenone degradation by fungi

CONCLUSIONS

Biodegrability of bisphenol and benzophenone were tested by using 16 fungal strains. Bisphenol A was degraded by the culyure of *Aspergillus oryzae* (79.7 % for 7 days), *Cheatomium globosum* (100 % for 6 days), *Penicillium janthillum* LM12 (79.6 % for 7 days), and *Rhizopus oryzae* (100 % for 6 days). Benzophenone could degrade by the culture of *Cladosporium* sp. DD618, *Geotricum candidum*, and *Rhizopus oryzae* could degrade benzophenone to less than detection limit. .

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