Yeast species utilizing uric acid, adenine, \( n \)-alkylamines or diamines as sole source of carbon and energy

WOUTER J. MIDDELHOVEN, HELEEN DE KIEVIT and ANDRÉ L. BIESBROEK

Laboratorium voor Microbiologie, Landbouwhogeschool, Hesselink van Suchtelenweg 4, 6703 CT Wageningen, The Netherlands


Yeast strains utilizing uric acid, adenine, monoamines or diamines as sole source of carbon and energy were isolated from several soil samples by the enrichment culture method. The most common species was \textit{Trichosporon cutaneum}. Strains of \textit{Candida catenulata}, \textit{C. famata}, \textit{C. parapsilosis}, \textit{C. rugosa}, \textit{Cryptococcus laurentii}, \textit{Stephanoascus ciferrii} and \textit{Tr. adeninovorans} were also isolated. All strains utilizing uric acid as sole carbon source utilized some primary \( n \)-alkyl-\( l \)-amines, hydroxyamines or diamines as well. The ascomycetous yeast strains showing these characteristics all belonged to species known to assimilate hydrocarbons. Type strains of hydrocarbon-positive yeast species which were not found in the enrichment cultures generally assimilated putrescine, some type strains also butylamine or pentylamine, but none assimilated uric acid. Methanol-positive species were not isolated. Type strains of methanol-positive and of hydrocarbon-negative species did not assimilate uric acid, butylamine or putrescine. Assimilation of putrescine as sole source of carbon and energy may be a valuable diagnostic criterion in yeast taxonomy.

INTRODUCTION

Growth of yeasts at the expense of unusual carbon sources such as methanol or hydrocarbons has been reported during the last decades. These phenomena have been considered from a taxonomic point of view (Hazeu et al., 1972; Bos and De Bruyn, 1973). Recently, utilization by some yeasts of uric acid (Middelhoven et al., 1983) and adenine (Middelhoven et al., 1984) as sole carbon source was demonstrated. All of these yeast strains were able to utilize some primary
n-alkylamines, e.g. butylamine, as well. These compounds had earlier been reported not to support growth of yeasts if supplied as sole source of carbon and energy (Van Dijken and Bos, 1981).

Most of the uric acid-assimilating yeast strains, viz. *Candida famata* TOX-2, *Trichosporon cutaneum* TOU-17 (Middelhoven et al., 1983) and *Tr. adeninovorans* TOA-3 (Middelhoven et al., 1984) showed a relatively high optimum temperature and tolerated high osmotic pressure. Since all of these strains were isolated from soil taken from a chicken-run, their natural habitat might be poultry litter or even the caecum of birds. To check this hypothesis enrichment cultures were performed with several soil samples, with and without birds' droppings.

Growth of yeasts at the expense of alkylamines, uric acid or hydrocarbons is accompanied with the development of microbodies, cell organelles that display the function of peroxisomes, of glyoxisomes or both (Middelhoven et al., 1983; Veenhuis and Harder, 1985; Veenhuis et al., 1985). Peroxisomes are also abundant in methanol-grown yeast cells (Van Dijken et al., 1975). From this viewpoint it is interesting to know whether uric acid- and amine-positive yeast species do utilize methanol or n-hydrocarbons as sole carbon source. This may throw some light on the taxonomic position of these yeast species.

**Materials and Methods**

**Yeast strains**

Apart from our own isolates and from strains described in earlier studies, several yeast strains from the culture collection of the Yeast Division of the Centraalbureau voor Schimmelcultures (CBS) at Delft were used. These strains are listed in Tables 1, 2 and 3. The nomenclature is according to Kreger-Van Rij (1984).

**Enrichment cultures**

The growth medium supplemented with five antibacterial antibiotics was as described earlier (Middelhoven et al., 1983). However, the concentration of KH₂PO₄ was 20 g·L⁻¹ instead of 1 g·L⁻¹ to increase the buffering capacity. Purine substrates were usually added to a concentration of 10 g·L⁻¹, amines and allantoin to 5 g·L⁻¹. The inoculum consisted of 5 to 10 g of soil sample which was added to 80 ml of growth medium in a 300-ml Erlenmeyer flask. Incubation took place in a rotary shaker at constant temperature, 25°C, 30°C or 35°C. The pH was 5.0 to 5.5 and was adjusted at intervals by addition of HCl (purine substrates) or KOH (amine substrates). When the pH did not change anymore, 1 ml was used as an inoculum for a second culture in the same medium that was treated similarly. From the enrichment cultures was streaked onto an agar medium of similar composition, or onto malt agar. Pure cultures