The metabolism of long-chain fatty acids and alcohols by 
*Candida tropicalis* and *Saccharomyces cerevisiae*

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The factors affecting the growth of *Candida tropicalis* and *Saccharomyces cerevisiae* on medium- and long-chain fatty acids and alcohols in batch culture were investigated. Growth on solid acids and alcohols dispersed in the medium is a maximum for tetradecanoic acid and tetradecanol. The poorer growth observed on shorter chain lengths can be ascribed to their toxicity to the yeasts, whilst the fall off in growth on the higher members is explained by their increasing insolubility in the medium.

When the longer-chain-length acids are dissolved in a non-metabolisable hydrocarbon, the growth of *C. tropicalis* is improved, but that of *S. cerevisiae* is unaffected. This suggests that acids can enter the cells of the former organism by direct contact with the hydrocarbon droplets. The surface of *S. cerevisiae* is too hydrophilic for this transfer mechanism to be possible.

Fatty acids dissolved in gas oil are utilized as substrates for the growth of *Candida tropicalis* in competition with the *n*-paraffins contained in the gas oil. Each fatty acid contributes to a constant proportion of yeast produced, but this proportion decreases as the chain is lengthened. Thus, in mixtures of gas oil with dodecanoic acid, 65% of the yeast is produced from metabolism of the acid, while with octadecanoic acid only 15% is produced. The log specific rates of utilization of the fatty acids within this range diminish linearly with increasing chain length.

**INTRODUCTION**

Recent studies of the toxicity of fatty acids to *C. tropicalis* (Bell, 1971; Bell and Trancart, 1973) have shown that straight-chain acids are readily metabolised and that those with chains longer than dodecanoic do not inhibit the growth of the yeast.

The further study of the metabolism of these longer-chain materials is evi-
dently of interest, since it has been established for a number of years that one of
the major pathways for the degradation of alkanes by microorganisms is via the
corresponding primary alcohol and carboxylic acid followed by β-oxidation
(Foster, 1962; Kallio, 1969). Analysis of the results obtained should yield useful
information concerning the chemical and physical properties of substrates which
control their rates of metabolism.

MATERIALS AND METHODS

Organisms. The same strain of *C. tropicalis* as used previously (Bell, 1971;
Bell and Trancart, 1973) and a strain of *S. cerevisiae* obtained from Lassafre, Lille.

*C. tropicalis* was maintained in continuous culture on a commercial *n-*
paraffin cut containing >99 % *n*-paraffins in the range *n*-C<sub>13</sub>–*n*-C<sub>18</sub>. Inocula for
batch cultures were obtained by centrifuging the culture issuing from the con-
tinuous fermenter and thoroughly washing the resulting yeast cake. Inocula
were also obtained from cultures of *C. tropicalis* and *S. cerevisiae* on Sabouraud
dextrose agar slopes in Roux bottles. The cells were washed twice with isotonic
saline and used to inoculate the batch fermenters.

Substrates. Batch cultures were carried out using the following fatty acids
and alcohols as the sole carbon source for growth: undecanoic acid supplied
by Prolabo, Paris; dodecanoic, tridecanoic, tetradecanoic, hexadecanoic, octa-
decanoic, nonadecanoic and eicosanoic acids, 1-dodecanol, 1-tetradecanol, 1-
hexadecanol, 1-octadecanol and 1-eicosanol supplied by Schuchardt, Munich.
Ultrafine dispersions of these solids were prepared using an “Ultra-Turrax”
homogeniser. They were also used dissolved in a non-metabolisable hydro-
carbon, “pristane” (2,6,10,14-tetramethylpentadecane) supplied by Kochlight,
and in a heavy gas oil containing 14.7 % *n*-paraffins in the range *n*-C<sub>16</sub> to *n*-C<sub>26</sub>.
This gas oil was the same as that used previously (Bell, 1971).

Growth studies. Media, equipment and methods for measuring specific growth
rates were identical to those described in an earlier investigation (Bell, 1971).
The total volume of the culture varied between 750 and 800 ml depending on the
substrate used. This was composed of 750 ml of medium, 0.75 g cells and the
substrate. The quantities of substrate used were: gas oil, 50 g (= 62.5 g/litre);
fatty acids and alcohols, 4.0 g (= 5.34 g/litre); pristane, 20 g (= 26.0 g/litre).