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RESEARCH PAPER

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Influence of nitrogen on lipid and biomass production by oleaginous yeast cultures

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This study was undertaken to investigate the influence of nitrogen sources on lipid production by different yeast cultures. Among the four nitrogen sources, yeast extract and peptone showed maximum lipid production in biomass (22.85 and 20.03 per cent, respectively) and they were at par with each other, while ammonium sulphate (16.70 per cent) and sodium nitrate (13.34 per cent) exhibited poor lipid accumulation. Yeast extract containing broth supported to produce maximum lipid in *Rhodotorula glutinis* (23.82 per cent), followed by *Rhodosporidium toruloides* (22.53 per cent) and *Lipomyces starkeyi* (22.21 per cent). High amount of biomass as 10.20, 10.16 and 10.14 g l^{-1} was also observed using yeast extract as nitrogen source, respectively of the above cultures. Further experiment on optimization of the concentrations ranging from 0.5 to 1.75 per cent revealed the production of higher lipids was under 0.75 per cent. Among the various concentrations evaluated, maximum lipid and biomass production was observed in *Rhodotorula glutinis* (31.3 per cent and 11.5 g l^{-1}), *Rhodosporidium toruloides* (29.72 per cent and 11.10 g l^{-1}) and *Lipomyces starkeyi* (28.50 per cent and 11.05 g l^{-1}), respectively at 0.75 per cent level. Reduction in biomass as well as lipid yield was observed when increase in concentrations of yeast extract beyond 1.0 per cent.

Key words : Nitrogen, Oleaginous yeast cultures, Cell biomass

INTRODUCTION

Lipids are indispensable for growth and survival of all organisms. They are important structural components of membranes and in many organisms play a crucial role in carbon and free energy storage. Lipids have high free-energy content and a tendency to form aggregates in water, which allow the compact unhydrated intracellular packing. In biological systems, fatty acids are mostly encountered as components of lipids. Lipids are organic compounds that are insoluble in water and soluble in organic solvents. Chemically, lipids vary to such a great extent that no structural definition is available (Gurr and Harwood, 1991).

Lipid accumulation is a dynamic process, which depends on the microorganism, the growth conditions (like pH, temperature, nutrients and aeration) and the growth phase. Most oleaginous microorganisms start to accumulate oil whenever excess carbon source is present. While, at the same time, growth is limited by another nutrient (Kessell, 1968; Ratledge and Evans, 1989). Lipid accumulation in an oleaginous microorganism begins when it exhausts a nutrient from the medium, usually this is nitrogen but with a surfeit of carbon, usually in the form of glucose, still remaining. However, the limitation in the supply of nitrogen arises, the cell proliferation is prevented, and the lipid that is now formed has to be stored within the existing cells which can no longer divide. In yeast, lipid bodies do not serve simply as inert lipid stores but play an important role in the biosynthesis, mobilization and trafficking of intracellular neutral lipids (Leber *et al*., 1994). Hence, by knowing the importance of N limitation on lipid production, this present study was undertaken to optimize the best source of nitrogen and concentration of N source for increasing the lipid production in oleaginous yeast cultures.

MATERIALS AND METHODS

In this experiment, influence of nitrogen on the ability of oleaginous yeast cultures on lipid production was tested with different nitrogen sources like yeast extracts, ammonium sulphate, sodium nitrate and peptone. Screening broth (Dai *et al*., 2007) containing Yeast extract - 15.0g/l, Peptone - 5.0g/l with 0.22 M carbon source was used for this experiment. Yeast extract in the broth was replaced with other nitrogen sources. The pH of the broth was adjusted to 6.0 and three replications were maintained for each nitrogen source. The broth was inoculated with 24 hrs old cultures grown in YEPG broth at 10 per cent level containing $28x10^4$ cfu/ml in the broth. (Saxena *et al*., 1998).

Inoculated flasks were incubated at 30^0C for 7 days in an incubator shaker at 200 rpm (Innova 4320, New Brunswick, USA) for the growth of culture. After seven days of growth, cultures were harvested by centrifugation