RESEARCH PAPER

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# Glucose utilization and lipid production by oleaginous yeast cultures

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The laboratory experiment was conducted to investigate the effect of different concentrations of glucose ranges from 0.11 to 0.66 M and utilization pattern (7 days) was studied for lipid production in oleaginous yeast cultures. Lipid and biomass production was gradually increased in response to glucose concentration. In *Rhodotorula glutinis, Rhodosporidium toruloides* and *Lipomyces starkeyi* lipid content reached maximum as 4.55 g $l^{-1}$ (40.26 per cent), 4.25 g $l^{-1}$ (38.20 per cent) and 4.23 g $l^{-1}$ (38.10 per cent), respectively at 0.55 M of glucose concentration. Biomass content was also high as 11.30, 11.13 and 11.10 g $l^{-1}$, respectively at 0.55 M concentration. While studying the utilization pattern, consumption of glucose was started from the second day with small amount of lipid and biomass production and it was gradually increased on third and fourth days of fermentation period. Maximum amount of lipid (4.80, 4.64 and 4.61 g $l^{-1}$) and biomass (11.40, 11.26 g, 11.20 g $l^{-1}$) was recorded on fifth day of fermentation with the utilization of 0.5 M of glucose. Then decline in lipid production was observed on sixth and seventh days. At the end of fermentation *Rhodotorula glutinis* utilized 0.55 M of carbon and exhibited 4.56 g $l^{-1}$ of lipid and 11.30 g $l^{-1}$ of biomass.

Key words : Oleaginous yeast, Lipids, Biomass, Carbon source, Glucose utilization

## INTRODUCTION

Lipid accumulation is a dynamic process, which depends on the microorganism, the growth conditions 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 (Ratledge and Evans, 1989). Depending on the microbial species and environmental conditions, the lipid content of microorganisms may vary between a few per cent to over 80 per cent of the biomass dry weight (Ratledge, 1993; Leman, 1997).

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. Glucose continues to be assimilated by the cells and is converted into triacylglycerols at more or less the same rate at which lipid was synthesized during the balance phase of growth. 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 (Ratledge, 2002). Lipids serve as storage materials in some lipid accumulating yeasts, e.g. *Rhodotorula graminis*. It is reported that yeasts can store up to 70 per cent of lipids in dry matter (Guerzoni *et al*., 1985).

Most yeasts produce small numbers of cytosolic lipid bodies, but the oleaginous yeasts can accumulate up to 25 per cent (w/w) storage lipid in response to a high carbon: nitrogen (C/N) ratio (Leber *et al*.,1994). Lipid bodies in *Saccharomyces cerevisiae* contain almost equal amounts of TAGs and sterol esters. Studies of Leber *et al*. (1995) imply that, 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. Hence, this present study was undertaken to optimize the glucose concentration for increasing the lipid production in oleaginous yeast cultures.

## MATERIALS AND METHODS

Laboratory experiments were conducted in the Department of Agricultural Microbiology, Tamil Nadu Agricultural University, Coimbatore (T.N.) in the year 2008 to study the influence of varied concentrations of glucose on biomass as well as lipid production by oleaginous yeast cultures. The pattern of glucose utilization for lipid production was also assed.

***Influence of levels of glucose on lipid and biomass production :***

Oleaginous yeast cultures *viz., Rhodotorula glutinis* (MTCC 247), *Rhodosporidium toruloides* (MTCC 1400) and *Lipomyces starkeyi* (MTCC 2974) were collected from MTCC, Chandigarh, India and used for the experiment.

Screening broth (Dai *et al.,* 2007) containing yeast extract -15.0g,/l, Peptone 5.0g/l was prepared without carbon source, in which different levels (0.11 M to 0.66 M) of glucose was added separately. The pH of the broth was adjusted to 6.0 and three replications were maintained