

Micellar effect on bioconversion of molasses to ethanol

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Abstract : The micellar effect of cetyltrimethyl-ammonium bromide on bioconversion of molasses to ethanol by *Saccharomyces cerevisiae* S-1605 was studied. It was found that cetyltrimethyl-ammonium bromide enhances the yield of ethanol to an extent of 9.55882% higher in comparison to control, i.e. 6.80 ml/100 ml.

(Keywords): Micellar effect, cetyltrimethyl-ammonium bromide, ethanol, *Saccharomyces cerevisiae* S-1605).

Introduction

A micelle (plural micelles or micellae, respectively) is an aggregate (or supramolecular assembly) of surfactant molecules dispersed in a liquid, forming a colloidal suspension. A typical micelle in water forms an aggregate with the hydrophilic "head" regions in contact with surrounding solvent, sequestering the hydrophobic single-tail regions in the micelle centre.¹⁻¹⁰ The investigation concerns chemical reactions occurring inside the particular type of biologically important aggregate, the micelles¹¹⁻¹².

Micelles either accelerates or retards the organic reactions depending on its nature¹³⁻²⁰. It is assumed that micelles are moderators of enzyme actions in some biological systems²¹⁻²⁴. Since micellar effect on fermentation studies especially alcoholic fermentation is relatively new and almost unexplored it needs careful and specific experimentations. In the present investigation the authors have made an attempt to study the effect of cetyltrimethyl-ammonium bromide on alcoholic fermentation by *Saccharomyces cerevisiae* S-1605

Experimental

The influence of cetyltrimethyl-ammonium bromide on bioconversion of molasses to ethanol by *Saccharomyces cerevisiae* S-1605

The composition of production medium for the bioconversion of molasses to ethanol by *Saccharomyces cerevisiae* S-1605 is prepared as follows : Molasses :25%; Malt extract : 0.40%; Yeast extract : 0.400%; Peptone : 0.60%; (NH₄)₂HPO₄ : 0.40%, pH : 5.0

Distilled water was added to make up the volume up to '100 ml'. The pH of the medium was adjusted to 5.0 by adding requisite amount of lactic acid.

Now, the same production medium for bioconversion of molasses to ethanol by *Saccharomyces cerevisiae* S-1605 was prepared for 99 fermentor-flasks, i.e., each containing 100 ml of the production medium. These fermentor flasks were then arranged in 10 sets each comprising 9 fermentor-flasks. The remaining 9 fermentor-flasks out of 99 fermentor-flasks were kept as control and these were also rearranged in 3 subsets each consisting of 3 fermentor flasks.

Now, M/1000 solutions of cetyltrimethyl-ammonium bromide was prepared and 1.0, 2.0, 3.0, 4.0, 5.0, 6.0, 7.0, 8.0, 9.0, and 10.0 ml of this solution was added to the fermentor-flasks of first 10 sets respectively. The control fermentor-flask contained no micelle. The total volume in each fermentor-flask was made upto '100 ml' by adding requisite amount of distilled water.

Table - 1
Micellar effect on bioconversion of molasses to ethanol

Concentration of micelle used A X 10 ^{-x} M	Incubation Period in hours	Yield of ethanol* in ml/100ml	Molasses* left unfermented in g/100 ml	%Diff. in the yield of ethanol in 50 hrs
Control	25	3.60	4.00	-
(-) micelle	50	6.80	1.08	-
	75	5.80	1.06	-
1.0 x 10 ⁻⁵ M	25	3.65	3.94	-
(+) micelle	50	7.06	0.84	+ 3.82352
	75	5.82	0.80	-
2.0 x 10 ⁻⁵ M	25	3.68	3.91	-
(+) micelle	50	7.12	0.82	+ 4.70588
	75	5.88	0.80	-
3.0 x 10 ⁻⁵ M	25	3.70	3.88	-
(+) micelle	50	7.25	0.80	+ 6.61764
	75	6.02	0.78	-
4.0 x 10 ⁻⁵ M	25	3.74	3.84	-
(+) micelle	50	7.35	0.69	+ 8.08823
	75	6.15	0.66	-
5.0 x 10 ⁻⁵ M**	25	3.79	3.82	-
(+) micelle	50	7.45***	0.68	+ 9.55882
	75	6.20	0.65	-
6.0 x 10 ⁻⁵ M	25	3.75	3.83	-
(+) micelle	50	7.43	0.70	+ 9.26470
	75	6.18	0.65	-
7.0 x 10 ⁻⁵ M	25	****	—	-
(+) micelle	50	7.40	0.68	+ 8.82352
	75	****	—	-
8.0 x 10 ⁻⁵ M	25	****	—	-
(+) micelle	50	7.39	0.69	-
	75	****	—	+ 8.67647
9.0 x 10 ⁻⁵ M	25	****	—	-
(+) micelle	50	7.35	0.70	-
	75	****	—	+ 8.08823
10.0 x 10 ⁻⁵ M	25	****	—	-
(+) micelle	50	7.30	0.72	-
	75	****	—	+ 7.35294

* Each value represents mean of three trials., ** Optimum concentration of micelle used.

*** Optimum yield of ethanol in 50 hours. (+) Values indicate % increase in the yield of ethanol after 50 hours. Experimental deviation (±) 1.5-3%.

Thus, the concentration of cetyltrimethyl ammonium bromide in first, second, third, fourth, fifth, sixth, seventh, eighth, ninth and tenth subsets were approximately as given below :

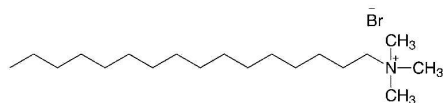
$a \times 10^{-x} \text{M}$, $1.0 \times 10^{-5} \text{M}$, $2.0 \times 10^{-5} \text{M}$, $3.0 \times 10^{-5} \text{M}$, $4.0 \times 10^{-5} \text{M}$, $5.0 \times 10^{-5} \text{M}$, $6.0 \times 10^{-5} \text{M}$, $7.0 \times 10^{-5} \text{M}$, $8.0 \times 10^{-5} \text{M}$, $9.0 \times 10^{-5} \text{M}$; and $10.0 \times 10^{-5} \text{M}$

Where, a =amount of micelles in ml, ie; from 1.0 ml to 10.0 ml, x = molarity of the solution respectively.

The fermentor-flasks were then steam sterilized, cooled, inoculated, incubated at 30°C and analysed colorimetrically after 25, 50 and 75 hours for ethanol²⁸ formed and molasses²⁹ left unfermented.

Results and Discussion

The influence of cetyltrimethylammonium bromide on bioconversion of molasses to ethanol :



Cetyltrimethylammonium

The table-1 shows that the cetyltrimethyl ammonium bromide has been found significantly stimulating for bioconversion of molasses to ethanol . The maximum yield of ethanol in the presence of cetyltrimethylammonium bromide was observed at $5.0 \times 10^{-5} \text{M}$ (7.45ml/100 ml) in 50 hrs of optimum incubation period which was found to be 9.55% higher in comparison to control flasks in the same time course of fermentation processes.

The higher concentration of cetyltrimethylammonium bromide were not much favourable for bioconversion of molasses to ethanol by *S. cerevisiae* S-1605. So, the gradual addition by cetyltrimethylammonium bromide after the concentration of $5.0 \times 10^{-5} \text{M}$ gradually slow down the bioconversion of molasses to ethanol

However, at all the concentrations of cetyltrimethylammonium bromide used, the bioconversion of molasses to ethanol has been found slight higher in comparison to the control fermentor-flasks.

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