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Bioproduction of H_3Cit by *Aspergillus niger* T-918 exposed to sodium pentadecyl sulfate

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Abstract: The efficacy of sodium pentadecyl sulfate on liquid state fermentative bioproduction of citric acid by *Aspergillus foetidus* T-501, *Aspergillus fischeri* T-611 6.968, *Aspergillus geganticus* T-715 , *Aspergillus oryzae* T-816, *Aspergillus niger* T-918 has been assessed. It has been observed that the fungal strain *Aspergillus niger* T-918 has been found most significant and effective for the citric acid fermentation process. It has been found that the compound, i.e., sodium pentadecyl sulfate has stimulatory effect on bioproduction of citric acid by *Aspergillus niger* T-918 and enhances the yield of citric acid to an extent of 13.652 % higher in comparison to control fermenter flasks, i.e., 10.747 g/100 ml under the optimized conditions.

(**Keywords:** Citric acid fermentation, diethyl sulphate (DES) and *Aspergillus candidus* F-569)

Introduction

Micelles are nanosized colloidal dispersions prepared from amphiphilic molecules, with a hydrophobic tail and a hydrophilic head. The hydrophobic core acts as a reservoir for hydrophobic drugs and the hydrophilic shell stabilizes the hydrophobic core.[1-10] The investigation concerns chemical reactions occurring inside the particular type of biologically important aggregate, the micelles[11-12].

Micelles either accelerates or retards the organic reactions depending on its nature[13-20]. It is assumed that micelles are moderators of enzyme actions in some biological systems[21-23]. There are several known micelles, but a very few micelles have been used in submerged fermentation processes[24-28]. Since micellar effect on fermentation studies especially lactic acid fermentation is relatively new and almost unexplored it needs careful and specific experimentations. In the present investigation the author has made an attempt to study the effect of sodium pentadecyl sulfate on bioproduction of H_3Cit by *Aspergillus niger* T-918.

Experimental

The influence of sodium pentadecyl sulfate on bioproduction of H_3Cit by *Aspergillus niger* T-918.

The composition of production medium for the bioproduction of H_3Cit by *Aspergillus niger* T-918 is prepared as follows:
Molasses : 30% w/v; Ammonium nitrate: 0.55%; Potassium dihydrogen phosphate: 0.55%; Magnesium sulphate- 0.55%; Distilled water to make up, 100 ml; pH, 2.0

The pH of the production medium was adjusted to 2.0 by adding requisite amount of KCI-HCI buffer solution, and this pH was also ascertained by a pH meter. The above composition medium represents volume of a fermentor flask, i.e., "100ml" on bioproduction of H_3Cit by *Aspergillus niger* T-918. Now, the same production medium of citric acid (H_3Cit) by *Aspergillus niger* T-918 was prepared for 99-fermentor flask, i. e; each contained '100ml' of production medium.

The above 99-fermentor flasks were

Table - 1
Bioproduction of H_3Cit by *Aspergillus niger* T-918 exposed to Sodium pentadecyl sulfate

Concentration of micell used A X 10^{-x} M	Incubation Period in days	Yield of ethanol*in ml/100ml	Molasses* left unfermented in g/100 ml	% of citric acid increased after 13 days
Control	11	7.951	5.526	-
(-) Micelle	13	9.456	4.422	-
	15	6.452	4.310	-
1.0x10^{-5}M	11	7.966	5.512	-
(+) Micelle	13	9.480	4.397	+0.253
	15	6.464	4.268	-
2.0x10^{-5}M	11	8.046	5.432	-
(+) Micelle	13	9.573	4.304	+1.237
	15	6.529	4.244	-
3.0x10^{-5}M	11	8.125	5.352	-
(+) Micelle	13	9.669	4.210	+2.252
	15	6.593	4.115	-
4.0x10^{-5}M	11	8.356	5.120	-
(+) Micelle	13	9.940	3.937	+5.118
	15	6.781	3.814	-
5.0x10^{-5}M	11	8.610	4.868	-
(+) Micelle	13	10.247	3.631	+8.365
	15	6.987	3.445	-
6.0x10^{-5}M**	11	8.984	4.493	-
(+) Micelle	13	10.747***	3.135	+13.652
	15	6.329	3.005	-
7.0x10^{-5}M	11	8.849	4.628	-
(+) Micelle	13	10.530	3.347	+11.357
	15	7.181	3.241	-
8.0x10^{-5}M	11	8.571	4.906	-
(+) Micelle	13	10.198	3.679	+7.846
	15	6.955	3.565	-
9.0x10^{-5}M	11	8.213	5.264	-
(+) Micelle	13	9.774	4.103	+3.362
	15	6.664	4.001	–
10.0x10^{-5}M	11	8.030	5.447	-
(+) Micelle	13	9.564	4.316	+1.142
	15	6.522	4.210	-

* Each value represents mean of three trials ** Optimum concentration of micelle used
*** Optimum yield of citric acid (+) values indicate % increase in the yield of citric acid after 13 days. Experimental deviation (±) 1.5-3%

then arranged to 11-sets each comprising of 9-fermentor flasks. Each set was then rearranged in 3-subsets, each consisting of 3-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.

After preparing the above sets of fermentor flasks M/1000 solution of Sodium pentadecyl sulfate was prepared and from the above micell solution 1.0, 2.0, 3.0, 4.0, 5.0, 6.0, 7.0, 8.0, 9.0 and 10 ml was added to the fermentation flasks of above 1st to 10th sets respectively. The control fermentor flasks contained no micelle.

Now, the total volume in each fermentor flasks was made upto 100 ml by adding requisite amount of distilled water. Thus, the molar concentration of Sodium pentadecyl sulfate in 1st, 2nd, 3rd, 4th, 5th, 6th, 7th, 8th, 9th and 10th subsets were approximately as given below : $A\times10^{-x}M$,i.e., $1.0\times10^{-5}M$to$10.0\times10^{-5}M$ respectively.

Where : A = amount of micelle, in ml, i.e. 1.0 ml ..... to 10 ml. x =Molarity of the micelle solution

The above fermentor flasks were then sterilized, cooled inoculated, incubated at 27^0C and analysed after 11, 13 and 15 days for citric acid[29] formed and molasses[30] left unfermented.

Results and Discussion

The data (vide table-1) reveals that the micelle, i.e., sodium pentadecyl sulfate stimulates the citric acid fermentation bioprocess and enhances the yield of citric acid upto its sodium pentadecyl sulfate concentrations from 1.0×10^{-5} to $6.0 \times 10^{-5}M$. The effect of sodium pentadecyl sulfate on the productivity (yield) of citric acid was gradually in increasing order and attains its best role at $6.0 \times 10^{-5}M$ where maximum yield of citric acid (H_3Cit), i.e., 10.747 g/100 ml is fetched in 13 days of optimum incubation period which is 13.652% higher in comparison to control fermentor flask, i.e., 9.456 g/100 ml.

In the second phase of micellar effect the molar concentration, i.e., from $7.0 \times 10^{-5}M$ to $10 \times 10^{-5}M$ the bioproduction of citric acid has been little enhanced but the order of citric acid productivity is reverse in respect to increasing molar concentrations of sodium pentadecyl sulfate. However, the bioproduction of H_3Cit by *Aspergillus niger* T-918 under the influence of each concentration of sodium,pentadecyl sulfate used has been stimulating and the yield of citric acid has been found greater than that obtained in the control fermentor flasks. In both the phase the order of productivity and % of citric acid (H_3Cit) formed is as below :

Phase- I

Concentration of sodium pentadecyl sulfate from $1.0x10^{-5}M$ to $6.0 \times 10^{-5}M$.

Productivity of citric acid :

0.253%, 1.237%, 2.252%, 5.118%, 8.365% and 13.652%

Phase - II

Concentration of sodium pentadecyl sulfate from $7.0 x10^{-5}$ M to $10.0 \times 10^{-5}M$.

Productivity of citric acid :

11.357%, 7.846%, 3.362%, and 1.142%

Exposure of fungal strain *Aspergillus niger* T-918 to sodium pentadecyl sulfate may produce a variety of effects. Depending upon the concentration of sodium pentadecyl sulfate to which fungal strain *Aspergillus niger* T-918 were exposed may influence disruption of cells, precipitation of cell protein, inactivation of enzymes and leakage of amino acids from the cells. Although the special mode of action is not very clear, there is a consensus that the lethal effect is associated with physical damage of the membrane structure of the cell surface, which initiates further deterioration.

Thus, it is concluded that sodium pentadecyl sulfate at lower concentrations is stimulatory and at higher concentrations is deterioratory for the bioproduction of H_3Cit by *Aspergillus niger* T-918 .

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