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Efficacy of Potassium Octyl Sulphate on Citric Acid Dioproduction

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Abstract:

The efficacy of potassium octyl sulphate on production of citric acid by some fungal strains such as Aspergillus carbonarius NCIM -2097, Aspergillus saitoi NCIM -2056, Aspergillus usumii NCIM - 2045, Aspergillus wentii NCIM - 2020 and Aspergillus-niger NCIM -2101 has been assessed. It has been found that the fungal strain Aspergillus-niger NCIM -2101 has been found most suitable to give higher yield of citric acid. The micelle; i.e. potassium octyl sulphate under trial has stimulatory effect on bioproduction of citric acid and enhances the yield of citric acid to an extent of 8.579% higher in comparison to control fermenter flasks, i.e., 8.683 g/100 ml in 12 days of optimum incubation period, 1.8 pH and 30^{0}C temperature with 28% (w/v) molasses solution along with other nutritional ingredients.

*(**Key words:** Molasses, citric acid fermentation, potassium octyl sulphate and Aspergillus niger NCIM-2101)*

Introduction

Micelles are spheres of lipids that form in aqueous solutions. In humans, they form from *bile salts*. These micellar aggregates help transport the digestive products of lipids to the intestine to be absorbed. Also, they are used as detergents.

A micelle is formed when a variety of molecules including soaps and detergents are added to water. The molecule may be a fatty acid, a salt of a fatty acid (soap), phospholipids, or other similar molecules[1-10]. The molecule must have a strongly polar "head" and a non-polar hydrocarbon chain "tail". The polar head of the molecule presents itself for interaction with the water molecules on the outside of the micelle. Micelles either accelerates or retards the organic reactions depending on its nature[11-20]. 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[24-31]. Since micellar effect on fermentation studies especially citric 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 potassium octyl sulphate on citric acid fermentation *by Aspergillus niger* NCIM-2101

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Experimental Methods

The influence of potassium octyl sulphate on production of citric acid by *Aspergillus niger* NCIM-2101. The composition of the production medium for production of citric acid by *Aspergillus niger* NCIM-2101 has been prepared as follows: Molasses: 28% (w/v), NH_4NO_3:0.25%, KH_2PO_4: 0.25%, $MgSO_4.7H_2O$: 0.25%, pH : 1.8

The pH of the production medium was adjusted to 1.8 by adding requisite amount of KCl-HCl buffer solution, and this pH was also ascertained by a pH meter. The above composition medium represents volume of a fermenter flask, i.e., "100mL" production medium for production of citric acid by *Aspergillus niger* NCIM-2101. Now, the same production medium for production of citric acid by *Aspergillus niger* NCIM-2101 was prepared for 99-fermenter flask, i. e; each contained '100mL' of production medium.

The above 99-fermenter flasks were then arranged to 11-sets each comprising of 9-fermenter flasks. Each set was then rearranged in 3-subsets, each consisting of 3-fermenter flasks. The remaining 9-fermenter flasks out of 99-fermenter flasks were kept as control and these were also rearranged in 3-subsets each consisting of 3-fermenter flasks.

After preparing the above sets of fermenter flasks M/1000 solution of potassium octyl sulphate was prepared and from the above potassium octyl sulphate 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 fermenter flasks contained no potassium octyl sulphate.

Now, the total volume in each fermenter flasks was made upto 100 mL by adding requisite amount of distilled water. Thus, the molar concentration of potassium octyl sulphate in 1st, 2nd, 3rd, 4th, 5th, 6th, 7th, 8th, 9th and 10th subsets were approximately as given below:

$A \times 10^{-x}$ M, i.e.,

1.0×10^{-5}M	6.0×10^{-5}M
2.0×10^{-5}M	7.0×10^{-5}M
3.0×10^{-5}M	8.0×10^{-5}M
4.0×10^{-5}M	9.0×10^{-5}M
5.0×10^{-5}M	10.0×10^{-5}M

A = amount of potassium octyl sulphate, in ml, i.e., 1.0 mL ..... to 10 mL.

x = Molarity of the potassium octyl sulphate solution

The above fermenter flasks were then sterilized, cooled inoculated and incubated at 32 C and analysed after 8,12 and 14 days for citric acid formed[31].

Table – 1 ***Efficacy of potassium octyl sulphate on citric acid bioproduction***

Concentration of micelle used $A \times 10^{-x}M$	Incubation period in days	Molasses* Left unfermented in g/100 ml	Yields of citric acid* in g/100 ml	% of Citric acid increased after 12 days
Control	8	6.295	5.705	-
(-) Micelle	12	8.683	3.318	-
	14	7.354	3.216	-
$1.0x10^{-5}M$	8	6.383	5.619	-
(+) Micelle	12	8.821	3.182	+ 1.589
	14	7.720	3.094	-
$2.0x10^{-5}M$	8	6.464	5.540	-
(+) Micelle	12	8.934	3.112	+2.890
	16	7.833	3.024	-
$3.0x10^{-5}M$	8	6.521	5.478	-
(+) Micelle	12	9.012	2.989	+ 3.789
	16	8.010	2.893	-
$4.0x10^{-5}M$	8	6.628	5.372	-
(+) Micelle	12	9.160	2.849	+ 5.493
	16	8.059	2.781	-
$5.0x10^{-5}M$	8	6.691	5.309	-
(+) Micelle	12	9.243	2.759	+ 6.449
	16	8.142	2.663	-
$6.0x10^{-5}M$**	8	6.823	5.179	-
(+) Micelle	12	9.428**	2.579	+ 8.579
	14	8.326	2.483	-
$7.0x10^{-5}M$	8	6.559	5.443	-
(+) Micelle	12	9.057	2.945	+ 4.307
	14	8.046	2.856	-
$8.0x10^{-5}M$	8	6.452	5.553	-
(+) Micelle	12	8.909	3.095	+ 2.602
	14	7.808	3.080	-
$9.0x10^{-5}M$	8	6.402	5.599	-
(+) Micelle	12	8.840	3.165	+ 1.808
	14	7.739	3.076	-
$10.0x10^{-5}M$	8	6.345	5.659	-
(+) Micelle	12	8.762	3.327	+ 0.909
	14	7.660	3.238	-

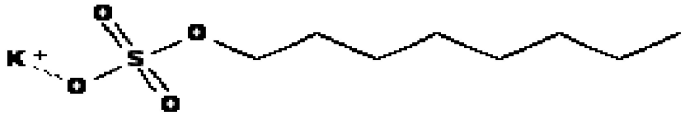
* Each value represents mean of three trials

** Optimum concentration of micelle used

*** Optimum yield of citric acid (+) values indicate % increase in the yield of citric acid after 12 days. Experimental deviation (±) 1.5-3%

Results and Discussion

The influence of potassium octyl sulfate



Potassium Octyl Sulfate

The data recorded in the table-1 shows that potassium octyl sulfate also has stimulatory effect on citric acid production by Aspergillus *niger* NCIM-2101.

The data (vide table-2) reveals that the micelle potassium octyl sulfate stimulates the citric acid fermentation process and enhances the yield of citric acid upto its potassium octyl sulfate concentrations from 1.0×10^{-5} to 6.0×10^{-5}M. The effect of potassium octyl sulfate on the productivity (yield) of citric acid was gradually in increasing order and attains its best role at 6.0×10^{-5}M where maximum yield of citric acid, i.e., 9.428g/100 mL is fetched in 12 days of optimum incubation period which is 8.579% higher in comparison to control fermentor flask, i.e., 8.683 g/100 mL.

In the second phase of micellar effect the molar concentration, i. e., from 7.0×10^{-5}M to 10×10^{-5}M the production of citric acid has been bit enhanced but the order of citric acid productivity is reverse in respect to increasing molar concentrations of potassium octyl sulfate. However, the citric acid production by Aspergillus *niger* NCIM-2101 under the influence of each concentration of potassium octyl sulfate used has been stimulating and the yield of citric acid has been found greater than that obtained in the control fermenter flasks. In both the phase the order of productivity and % of citric acid formed is as below:

Phase- I

Concentration of potassium octyl sulfate from 1.0×10^{-5}M to 6.0×10^{-5}M.

Productivity of citric acid:

1.589%, 2.890%, 3.789%, 5.493%, 6.449%, and 8.579%

Phase - II

Concentration of potassium octyl sulfate from 7.0×10^{-5} M to 10.0×10^{-5}M.

Productivity of citric acid:

4.307%, 2.602%, 1.808% and 0.909%

Exposure of fungal strain *Aspergillus niger* NCIM-2101 to potassium octyl sulfate may produce a variety of effects. Depending upon the concentration of potassium octyl sulfate to which fungal strain *Aspergillus niger* NCIM-2101 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.

Conclusions

Thus, it is concluded that potassium octyl sulfate at lower concentrations is stimulatory and at higher concentrations is detrimental for citric acid production by Aspergillus *niger* NCIM-2101.

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