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NOTE

Effect of Some Antifoam Agents and Oxygen Transfer Rate on Citric Acid Production by Submerged Fermentation

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The effect of antifoam agents, *viz.*, octadecanol, groundnut oil and silicone oil and oxygen transfer rate (OTR) has been studied on citric acid yield by *A. niger* under submerged fermentation. It has been observed that groundnut oil gave the maximum yield of citirc acid in comparison to octadecanol and silicone oil. So far as the OTR is concerned a volume of 100 mL of the medium per one litre flask is optimum for the production of citric acid.

Citric acid fermentation has been placed in the category of difficult processes. In India, several attempts have been made to develop an indigneous citric acid process for good yield using different mutagenic chemicals, trace-elements, vitamins and amino acids.[1-7] Work on the development of a process for the production of citric acid by fermentation was started in this laboratory[8-10]. The present study was undertaken to assess and analyse the fermentative production of citric acid by *A. niger* exposed to some antifoam agents and oxygen transfer rate.

Production medium: The composition of the production medium was prepared as follows:

Sucrose	:	140 g	NH_4NO_3	:	2.5 g
KH_2PO_4	:	1.0 g	$MgSO_4 \cdot 7H_2O$	:	0.25 g
Distilled water	:	1 L	pH	:	4.5–5.0
Temperature	:	29–30°C			

Strain: *Aspergillus niger* was used in the present study.

Screening of Micro-organisms: Soil samples were collected from various places and plated by serial dilution method on streptomycin rose bengal agar. The plates were incubated for 5 days at 30°C and colonies of *Aspergillus niger* were transferred to Sabouraud's agar.

Assay methods: Total acidity in the fermentation broth was determined by titration against 0.1 N NaOH. Citric acid was estimated by the method of Leopold and Valtr[11]. Purity of citric acid was determined by paper chromatography using

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ethyl acetate : acetic acid : water (2 : 1 : 1 by vol). The percentage of citric acid produced was calculated on the basis of the initial sugar. The observations made for citric acid production in 8 days of optimum incubation period are recorded in Tables 1 and 2.

TABLE-1
EFFECT OF ANTIFOAM AGENT ON CITRIC ACID PRODUCTION
(incubation period: 8 days)

Antifoam agents	Citric acid yield	
	mg/mL	% Conversion
Control	56.80	40.57
Ostadecanol	55.90	39.92
Silicone oil	57.50	41.07
Groundnut oil	73.80*	52.71

TABLE-2
EFFECT OF OTR ON THE PRODUCTION OF CITRIC ACID
(incubation period: 8 days)

Volume litre flask	Equivalent sulphite value (mole/O_2/L/h)	Citric acid yield	
		mg/mL	% Conversion
25	201	48.50	34.64
50	107	56.80	40.57
75	85	63.20	45.14
100	57	70.30*	50.21
125	50	63.50	45.35
150	39	56.20	40.14
200	36	45.60	32.57

Experimental deviation ±1.0 to 1.5%.
*Maximum production of citric acid.

Effect of antifoam agent: Groundnut oil was used as the antifoam agent. Effects of other antifoam agents were also studied. The effect of octadecanol, groundnut oil and silicone oil on citric acid yield is given in Table-1. Groundnut oil gave the maximum yield of citric acid in a comparative study. Oils as such are rich sources of ***acetyl coenzyme-A*** which would act as a precursor of citric acid and would trigger its fermentative productivity. Thus, oil in addition to acting as antifoam agent also increases the yield of citric acid. There was no effect of other antifoam agents on citric acid yield though the foam was controlled.

Effect of oxygen transfer rate: Any fermentation process depends to a large extent on the oxygen transfer rate (OTR). In the present studies, OTR was determined by Cooper's[12] method in distilled water by varying its volume and expressed as sulphite value. Equivalent volume of the production medium was used for citric acid production. A perusal Table-2 shows that a volume of 100 mL

of the medium per one litre flask is optimum for the production of citric acid. This corresponds to a sulphite value of 57 mmoles of O_2/L/h. At higher sulphite values the citric acid production decreased and sugar consumption increased, whereas at lower sulphite values citric acid yields as well as sugar consumption decreased.

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