

Influence of ricinine on bioproduction of ethanol

Pankaj Kumar

Chemical Research Laboratory,
Department of Chemistry, Magadh University, Bodh-Gaya
Email: pankajkumar7p5@gmail.com

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Abstract : The efficacy of ricinine on microbial production of ethanol by *Saccharomyces cerevisiae* NCIM -2096 has been assessed. It has been found that the alkaloid under trial, i.e., ricinine at 7×10^{-5} M molar concentration enhances the microbial production of ethanol by *Saccharomyces cerevisiae* NCIM -2096 to an extent of 14.035% higher in comparison to control fermentor flasks, i.e., 5.70 ml/100mL in 58 hrs of incubation period, 4.6 pH and 31°C temperature with 24% (w/v) molasses solution.

(Keywords: Molasses, ethanol, ricinine *Saccharomyces cerevisiae* NCIM -2096)

Introduction

Alkaloid, any of a class of naturally occurring organic nitrogen-containing bases. Alkaloids have diverse and important physiological effects on humans and other animals. Well-known alkaloids include morphine, strychnine, quinine, ephedrine, and nicotine.

Most of the alkaloids have a bitter taste and are optically active. All the alkaloids due to basic character form crystalline salts soluble in water with inorganic and organic acids. Alkaloids are made by all living things, but many alkaloids are isolated from plants. Most plants only produce a few types of alkaloids and the function of them in plants is not clear. Some scientists think they may be involved in seed production. Regardless of their role in plants, many alkaloids have uses in medicine for humans.

The literature is inadequate on data pertinent to the participation of alkaloids on

fermentation process and poisonous nature of the alkaloids. The influence of alkaloids specially on microbes have not been studied extensively¹. Since some alkaloids²⁻¹⁷ are known to be produced during some fermentation process it is obvious that such alkaloids being toxic are not toxic to the organisms involved in the fermentation process. The present study was undertaken to assess and analyse the microbial production of ethanol by *Saccharomyces cerevisiae* NCIM -2096 exposed to ricinine.

Experimental

The influence of ricinine on microbial production of ethanol by *Saccharomyces cerevisiae* NCIM -2096.

The composition of the production medium for microbial production of ethanol by *Saccharomyces cerevisiae* NCIM -2096 is prepared as follows :

Molasses : 24% (w/v), Malt-Extract : 1.75% , Yeast-Extract : 1.75%, Peptone : 1.75% Distilled water : To make up 100 ml, pH : 4.6, Distilled water was added to make up the volume up to '100 ml'. The pH of the medium was adjusted to 4.6 by adding requisite amount of lactic acid. Now, the same production medium for ethanol production by *Saccharomyces cerevisiae* NCIM -2096 was prepared for 99 fermentor-flasks, i.e., each containing 100 ml of 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.

Table -1
Influence of ricinine on bioproduction of ethanol

Concentration of alkaloid used A x 10 ^{-x} M	Incubation period in hours	Yield of ethanol* in ml/100 ml	Molasses substrate* left unfermented in g/100 ml	% of ethanol after 58 hrs of incubation pd.
Control	40	5.15	3.102	—
(–Alkaloid)	58	5.70	2.529	—
	62	4.60	2.418	—
1.0 x 10 ⁻⁵ M	40	5.19	3.068	—
(+ Alkaloid)	58	5.76	2.497	(+) 1.052
	62	4.70	2.368	—
2.0 x 10 ⁻⁵ M	40	5.25	3.009	—
(+ Alkaloid)	58	5.86	2.435	(+) 2.807
	62	4.79	2.330	—
3.0 x 10 ⁻⁵ M	40	5.35	3.018	—
(+ Alkaloid)	58	5.94	2.319	(+) 4.210
	62	4.88	2.217	—
4.0 x 10 ⁻⁵ M	40	5.44	2.720	—
(+ Alkaloid)	58	6.06	2.086	(+) 6.315
	62	5.02	2.073	—
5.0 x 10 ⁻⁵ M	40	5.56	2.597	—
(+ Alkaloid)	58	6.16	1.999	(+) 8.070
	62	5.11	1.895	—
6.0 x 10 ⁻⁵ M	40	5.71	2.433	—
(+ Alkaloid)	58	6.34	1.975	(+) 11.238
	62	5.29	1.869	—
7.0 x 10 ⁻⁵ M**	40	5.87	2.279	—
(+ Alkaloid)	58	6.50***	1.514	(+) 14.035
	62	5.45	1.412	—
	40	5.66	2.366	—
8.0 x 10 ⁻⁵ M	58	6.28	1.746	(+) 10.175
(+ Alkaloid)	62	5.19	1.642	—
	40	5.37	2.730	—
9.0 x 10 ⁻⁵ M	58	5.98	2.041	(+) 4.912
(+ Alkaloid)	62	4.89	2.030	—
	40	5.25	2.892	—
10.0 x 10 ⁻⁵ M	58	5.82	2.549	(+) 2.105
	62	4.79	2.444	—

* Each value represents mean of three trials. ** Optimum concentration of alkaloid

*** Optimum yield of ethanol (+) Values indicate % increases in the yield of ethanol

Experimental deviation $\pm$ 2.5 – 3.5%

Now, M/1000 solution of ricinine 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 ricinine. The total volume in each fermentor-flask was made upto '100 ml' by adding requisite amount of distilled water.

Thus, the concentration of ricinine in first, second, third, fourth, fifth, sixth, seventh, eighth, ninth and tenth subsets were approximately as given below : $A \times 10^{-x} M$, $1.0 \times 10^{-5} M$ to $10.0 \times 10^{-5} M$ respectively. Where, A = amount of ricinine in ml, i.e.; from 1.0 ml to 10.0 ml. x = molarity of the ricinine solution.

The fermentor-flasks were then steam sterilized, cooled, inoculated, incubated at $31^{\circ}C$ and analysed colorimetrically after 40, 58, and 62 hours for ethanol¹⁸ formed and molasses sugars¹⁹ left unfermented.

Results and Discussion

The influence of ricinine on ethanol production by *Saccharomyces cerevisiae* NCIM -2096

The data recorded in the table-1 shows

that the alkaloid, i.e; ricinine has been found stimulatory and beneficial for ethanol production by *Saccharomyces cerevisiae* NCIM -2096 at all its molar concentrations, i.e; from $1.0 \times 10^{-5} M$ to $10.0 \times 10^{-5} M$ in two phases.

In the first phase the molar concentrations of the alkaloid, i.e ; ricinine from $1.0 \times 10^{-5} M$ to $7.0 \times 10^{-5} M$ is significant and the production of ethanol gradually increases till a maximum value is reached at $7.0 \times 10^{-5} M$, i.e; 6.50 ml/100ml in 58 hours of optimum incubation period which is 14.035% higher in comparison to control, i.e; 5.70ml/100ml.

In the second phase of the alkaloid effect, i.e., ricinine at $8.0 \times 10^{-5} M$ and onwards the molar concentration of ricinine on ethanol production by *Saccharomyces cerevisiae* NCIM -2096 has been increased but in lesser amount in the presence of ricinine. So, the gradual addition of ricinine after the optimum concentration of $6.0 \times 10^{-5} M$ gradually slows down and decreases the process of the ethanol production by *Saccharomyces cerevisiae* NCIM -2096 and the part of % increase at $8.0 \times 10^{-5} M$ to $10 \times 10^{-5} M$ molar concentration of ricinine is as follows:

10.175%, 4.912%, and 2.105% respectively.

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