

Molasses bioconversion to ethanol by *Saccharomyces cerevisiae* RY-20 exposed to nicotine sulphate

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Abstract : The efficacy of nicotine sulphate on microbial bioconversion of molasses to ethanol by *Saccharomyces cerevisiae* RY-20 has been assessed. It has been found that the alkaloid under observation, i.e., nicotine sulphate at 6×10^{-5} M molar concentration enhances the microbial bioconversion of molasses to ethanol by *Saccharomyces cerevisiae* RY-20 to an extent of 17.099% higher in comparison to control fermentor flasks, i.e., 4.62 ml/100mL in 58 hrs of incubation period, 4.5 pH and 30°C temperature with 15% (w/v) molasses solution.

(Keywords: Molasses, ethanol, nicotine sulphate *Saccharomyces cerevisiae* RY-20)

Introduction

Nicotine is a widely used stimulant and potent parasympathomimetic alkaloid. The hydrochloride and sulfate salts become optically inactive if heated in a closed vessel above 180°C. Nicotine sulfate, solution appears as an clear colorless aqueous solution. 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 bioprocess. The present study was undertaken to assess and analyse the microbial bioconversion of molasses to ethanol by *Saccharomyces cerevisiae* RY-20 exposed to nicotine sulphate

Experimental

The influence of nicotine sulphate on microbial bioconversion of molasses to ethanol by *Saccharomyces cerevisiae* RY-20. The composition of the production medium for microbial bioconversion of molasses to ethanol by *Saccharomyces cerevisiae* RY-20 is prepared as follows :

Molasses : 15% (w/v), Malt-Extract : 1.25% , Yeast-Extract : 1.25%, Peptone : 1.25% Distilled water : To make up 100 ml, pH : 4.5, Distilled water was added to make up the volume up to '100 ml'. The pH of the medium was adjusted to 4.5 by adding requisite amount of lactic acid.

Now, the same production medium for ethanol production by *Saccharomyces cerevisiae* RY-20 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.

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

Table - 1
Microbial bioconversion of molasses to ethanol by *Saccharomyces cerevisiae* RY-20
exposed to hygrine

Concentration of alkaloid used $A \times 10^{-x} \text{ M}$	Incubation Period in hours	Yield of ethanol* in ml/100 ml	Molasses sugars* left unfermented in g/100 ml	% Difference in yield of ethanol after 58 hours in comparison to control.
Control				
(-) Alkaloid $1.0 \times 10^{-5} \text{ M}$	58	4.62	2.483	—
(+) Alkaloid $2.0 \times 10^{-5} \text{ M}$	58	4.67	2.433	+1.082
(+) Alkaloid $3.0 \times 10^{-5} \text{ M}$	58	4.77	2.334	+3.246
(+) Alkaloid $4.0 \times 10^{-5} \text{ M}$	58	4.86	2.243	+5.194
(+) Alkaloid $5.0 \times 10^{-5} \text{ M}$	58	5.09	2.013	+10.173
(+) Alkaloid $6.0 \times 10^{-5} \text{ M}^{**}$	58	5.27	1.834	+14.069
(+) Alkaloid $7.0 \times 10^{-5} \text{ M}$	58	5.41***	1.693	+17.099
(+) Alkaloid $8.0 \times 10^{-5} \text{ M}$	58	5.23	1.873	+13.203
(+) Alkaloid $9.0 \times 10^{-5} \text{ M}$	58	5.04	2.065	+9.090
(+) Alkaloid $10.0 \times 10^{-5} \text{ M}$	58	4.81	2.293	+4.112
(+) Alkaloid	58	4.72	2.383	+2.164

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

*** Optimum yield of ethanol in 58 hours. (+) Values indicate % increase in the yield of ethanol in comparison to control. Experimental deviation ($\pm$) 1.5–3%.

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

$A \times 10^{-x} \text{ M}$, $1.0 \times 10^{-5} \text{ M}$ to $10.0 \times 10^{-5} \text{ M}$ respectively.

Where, A = amount of nicotine sulphate in ml, ie; from 1.0 ml to 10.0 ml.

x = molarity of the nicotine sulphate solution.

and analysed colorimetrically after 48, 58, and 65 hours for ethanol¹⁸ formed and molasses sugars¹⁹ left unfermented.

Results and Discussion

The influence of nicotine sulphate on bioconversion of molasses to ethanol by *Saccharomyces cerevisiae* RY-20

The fermentor-flasks were then steam sterilized, cooled, inoculated, incubated at 30°C

The data recorded in the table-1 shows that nicotine sulphate has stimulatory effect on

bioconversion of molasses to ethanol by *Saccharomyces cerevisiae* RY-20.

The data (table-1) reveals that the alkaloid, i.e., nicotine sulphate stimulates the bioconversion of molasses to ethanol by *Saccharomyces cerevisiae* RY-20 and enhances the yield of ethanol upto its nicotine sulphate concentrations from 1.0×10^{-5} M to 6.0×10^{-5} M in two phases:

In the first phase, i.e; from 1.0×10^{-5} M to 6.0×10^{-5} M the effect of nicotine sulphate on the productivity (the yield) of ethanol was gradually in increasing order and achieves its best function at 6.0×10^{-5} M where maximum yield of ethanol, i.e; 5.41 ml/100 ml is obtained in 58 hours of optimum incubation period which is 17.099% higher in comparison to control fermentor flasks (4.62ml/100ml).

In the second phase of coumarins effect the molar concentrations, i.e; from 7.0×10^{-5} M to 10.0×10^{-5} M the production of ethanol has been enhanced but the order of ethanol productivity is found reversed in respect to increasing molar

concentrations of nicotine sulphate. However, the bioconversion of molasses to ethanol by *Saccharomyces cerevisiae* RY-20 under the influence of each concentration of nicotine sulphate used has been stimulating and the yield of ethanol has been found greater than that obtained in the control fermentor flasks.

Concentration of nicotine sulphate on bioconversion of molasses to ethanol by *Saccharomyces cerevisiae* RY-20

from 1.0×10^{-5} M to 6.0×10^{-5} M.

Productivity of ethanol: 1.082%, 3.246%, 5.194%, 10.173%, 14.069%, and 17.099%

Concentration of nicotine sulphate from 7.0×10^{-5} M to 10×10^{-5} M.

Productivity of ethanol : 13.203%, 9.090%, 4.112% and 2.164%

Thus, it is concluded that nicotine sulphate at lower concentrations is found stimulatory and at higher concentrations it is deterioratory for bioconversion of molasses to ethanol by *Saccharomyces cerevisiae* RY-20

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