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Biotic production of lactic acid by LABs exposed to some carbaryl

Prachi Prakash
Department of Chemistry, B.N. Mandal.University , Madhepura, Bihar
E-mail: prach.mahi@gmail.com

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Abstract : The global lactic acid market size was estimated at USD 3.37 billion in 2023 and is expected to grow at compound annual growth rate (CAGR) of 8.0% from 2024 to 2030. This growth is driven by increasing demand from various industries. The demand for lactic acid is also driven by government regulations promoting eco-friendly and sustainable products. The impact of carbaryl, i.e., -naphthyl-N-methylcarbamate on lactic acid fermentation by some lactic acid bacteria such as *Lactobacillus casei* NCIM -2063, *Lactobacillus pentosus*, NCIM-2256, *Lactobacillus leichmannii* NCIM-2172 and *Lactobacillus delbrueckii* NCIM-2353 has been studied. The strain *Lactobacillus pentosus* NCIM - 2256 has been found big lactic acid producer. It has been observed that the carbaryl, i.e., 1- naphthyl-N - methylcarbamate at its concerntration of 7.0×10^{-5} M enhances the yield of lactic acid to an extent of 16.144 % higher in comparison to control, i.e. 9.675 g/100ml under optimised parametric conditions.

(Keywords : Lactic acid Fermentation, LABs, Carbaryl, *Lactobacillus pentosus* NCIM - 2256.).

Introduction

Carbaryl has been studied for its potential genotoxic and mutagenic effects. While its not classified as a strong mutagen. However, some studies have found no significant genotoxic or mutagenic effects. Carbaryl should be handled with caution and should take protective measure to minimize exposure. Carbaryl might inhibit the growth of lactic acid bacteria, affecting fermentation efficiency. Carbaryl could interfere with enzyme activity or metabolic pathways involved in lactic acid production. Carbaryl could influence fermentation rates, potentially leading to changes in product formation and yield. The impact of carbaryl on lactic acid fermentation might depend on its concerntration. Different lactic acid bacteria (LABs) might exhibit varying sensitivities to carbaryl. Research on the effects of carbaryl on microorganisms can help to understand its impact on lactic acid fermentation. A mutagen is a chemical or physical agent capable of inducing change in DNA called mutagen. Examples of mutagens include tobacco product, radio active substances, X-rays, ultraviolet radiation and a wide variety of chemical. Chemical mutagens are standard tools for mutagenesis in a variety of organisms, and they are a primary means of creating mutations in phenotype-based screens in most genetic systems. Chemical mutagens have also been used successfully in the mutagenesis.

Chemical mutagens are compounds that increase the frequency of some types of mutation.[1-11] Mutagenic agents are used to induce favorable mutations at high frequency that include ionizing radiation and chemical mutagens. Many chemicals have clastogenic (chromosome damaging) effects on plants via reactive oxygen-derived radicals.[12-15] Many researchers compared the mutagenic efficiencies of different mutagens on different crops and their results seem to be entirely specific for particular species and even varieties. While many researchers found chemical mutagens are to be more effective than physical ones[16-19] and many others researchers found the reverse case.

A number of workers[20-22] have reported the role of chemical mutagens in enhancing genetic variability in higher plants because it is the fundamental characteristics to successful breeding programs in vegetatively and sexually propagated plants. A large number of chemical mutagens are recorded as a good agent for different microbes and microbial processes[23-46]. Thus, from the above brief review it is evident that chemical mutagens are required for genetic manupulation and exploitation specially for lactic acid fermentation and in view of this the authoress has studied the influence of 1-naphthyl-N-methyl carbamate on production of lactic acid by *Lactobacillus pentosus* NCIM-2256.

Experimental

Compositions of the production medium :

The composition of the production medium for production of lactic acid by *Lactobacillus pentosus* NCIM-2256 exposed to 1-naphthyl-N-methyl carbamate is as follows : Molasses : 28% (w/v), Malt Extract : 1.50% Yeast Extract : 1.50%, Peptone : 1.50%, $(NH_4)_2HPO_4$: 1.50%, $CaCO_3$: 12.0%, pH : 6.0

(The pH was Adjusted by adding requisite amount of phosphate-buffer solution). Distilled water : To make up 100 ml.

Assay methods :

Evaluation of lactic acid formed and molasses left unfermented was made colorimetrically[47-48].

Sterilization : The growth and production medium was sterilized in an autoclave maintained at 15 lbs steam pressure for 30 minutes.

Strain : *Lactobacillus pentosus* NCIM-2256 has been employed in the present study. The strain was procured from NCL - Pune, India

Age of the inoculum : 48 hours old.

Quantum of the inoculum:0.5 ml bacterial suspension of *Lactobacillus pentosus* NCIM-2256 **Incubation period :** 4, 7 and 9 days

Concentration of 1-naphthyl-N-methyl carbamate used :

M/1000 solution of 1-naphthyl-N-methyl carbamate under trial has been prepared and 1.0 x 10^{-5}M to 10x 10^{-5} M molar concentration of 1-naphtyl-N-methyl carbamate has been employed.

Results and Discussion

The influence of 1-naphthyl-N-methylcarbamate

The data recorded in the table-1 shows that the chemical mutagen 1-naphthyl-N-methyl carbamate in its molar concentrations from 1.0×10^{5}M to 7.0×10^{-5} M has stimulatory effect on bioproduction of lactic acid by *Lactobacillus pentosus* NCIM-2256 . The yields of lactic acid obtained in the control fermenter flasks has been found to be lower than that obtained from each of the fermentor flasks containing chemical mutagen, i.e. 1-naphthyl-N-methylcarbamate

The maximum yield of lactic acid, i.e., 11.237g/100 ml. in the presence of 1-naphthyl-N-methylcarbamate, i.e., at the molar concentration 7.0 x 10^{-5} M was found in 7 days of optimum incubation period, which is 16.144% higher in comparison to control flask i.e.,9.675 g/100ml.

However, at higher concentrations (8.0 x 10^{-5} M, 9.0 × 10^{-5} M a 10.0 x 10^{-5} M) of the chemical mutagen, i.e., 1-naphthyl-N-methyl carbamate the production of lactic acid was found to be in decreasing order. Thus, it is obvious from the results that the chemical mutagen 1-naphthyl-N-methylcarbamate under trial is much detrimental and inhibitory at higher concentration for bioproduction of lactic acid by *Lactobacillus pentosus* NCIM-2256.

It is interesting to note that the chemical mutagen used in the present investigation 1-Naphthyl-N-methylcarbamate in lower molar concentrations has given better yield of lactic acid in comparison to control.

Thus, It has been summarized that 1-

Table - 1
Biotic production of lactic acid by LABs exposed to some carbaryl

Concentation of mutagen used a x 10^{-x} M	Incubation period in days	Yield of lactic acid* in g/100 ml	Molasses substrate* left unfermented in g/100 ml	% of lactic acid increase in 7 days of incubation pd.
Control	7	9.675	2.115	–
1.0 x 10^{-5} M	7	9.762	2.029	+0.899
2.0 x 10^{-5} M	7	9.937	1.859	+2.708
3.0 x 10^{-5} M	7	10.037	1.753	+3.741
4.0 x 10^{-5} M	7	10.247	1.544	+5.912
5.0 x 10^{-5} M	7	10.510	1.285	+8.630
6.0 x 10^{-5} M	7	10.763	1.025	+11.245
7.0 x 10^{-5} M **	7	11.237***	0.555	+16.144
8.0 x 10^{-5} M	7	10.480	1.315	+8.320
9.0 x 10^{-5} M	7	10.183	1.610	+5.250
10.0 x 10^{-5} M	7	9.689	1.905	+2.211

* Each value represents mean of three trials. ** Optimum concentration of mutagen.
*** Optimum yield of lactic acid (+) Values indicate % increase in the yield of lactic acid
Experimental deviation $\pm$ 2.5 – 3.5%

naphthyl-N-methylcarbamate, significantly influences the bioproduction of lactic acid by *Lactobacillus pentosus* NCIM-2256 and enhances the yield to an extent of 16.144% higher in comparison to the control in 7 days of optimum incubation period.

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