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Mircobial production of lactic acid by *Lactobacillus pentosus* NCIM-2912 exposed to iodopropynyl butylcarbamate

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Abstract: The efficacy of iodopropynyl butylcarbamate on microbial production of lactic acid by *Lactobacillus viridescens* NCIM–2167, *Lactobacillus plantarum* NCIM - 2083, *Lactobacillus fermentum* NCIM - 2070 and *Lactobacillus pentosus* NCIM-2912 has been assessed.It has been found that the lactic acid bacteria *Lactobacillus pentosus* NCIM-2912 is most effective for the higher production of lactic acid. It has been observed that the mutagen, i.e., iodopropynyl butylcarbamate at concentrations 8.0×10^{-5}M enchances the microbial production of lactic acid to an exent of 16.300% higher in comparison to control while at 9.0×10^{-5}M and onwards concentrations of iodopropynyl butylcarbamate inhibits the production of lactic acid to a great extent in comparison to control.

(**Keywords:** Lactic acid fermentation, iodopropynyl butylcarbamate and *Lactobacillus pentosus* NCIM-2912).

Introduction

Mutations can involve large sections of DNA becoming duplicated, usually through genetic recombination.[1-12] These duplications are a major source of raw material for evolving new genes, with tens to hundreds of genes duplicated in animal genomes every million years.[13] Most genes belong to larger families of genes of shared ancestry.[14] Novel genes are produced by several methods, commonly through the duplication and mutation of an ancestral gene, or by recombining parts of different genes to form new combinations with new functions.[15, 16] Here, domains act as modules, each with a particular and independent function, that can be mixed together to produce genes encoding new proteins with novel properties.[17] For example, the human eye uses four genes to make structures that sense light: three for color vision and one for night vision; all four arose from a single ancestral gene.[18] Another advantage of duplicating a gene (or even an entire genome) is that this increases redundancy; this allows one gene in the pair to acquire a new function while the other copy performs the original function.[19,20] Other types of mutation occasionally create new genes from previously noncoding deoxyribonucleic acid.[21,22] Changes in chromosome number may involve even larger mutations, where segments of the deoxyribonucleic acid within chromosomes break and then rearrange[23-24].

The influence of mutagens in fermentation technology specially lactic acid fermentation has been studied extensively. Iodopropynyl butylcarbamate is one of the few chemical mutagen which has found effective chemical mutagen in fermentations.

The present study was undertaken to microbial production of lactic acid by *Lactobacillus pentosus* NCIM-2912 exposed to iodopropynyl butylcarbamate.

Experimental

Compositions of the production medium :

The influence of iodopropynyl butylcarbamate on mircobial production of lactic acid by *Lactobacillus pentosus* NCIM-2912 . The composition of the mircobial production of lactic acid by *Lactobacillus pentosus* NCIM-2912 exposed to iodopropynyl butylcarbamate is as follows :

Table -1
Mircobial production of lactic acid by *Lactobacillus pentosus* NCIM-2912 exposed to iodopropynyl butylcarbamate

Concentration of Mutagen	Incubation period in days	Yield of lactic acid* in g/100 ml	Molasses* left unfermented in g/100 ml	% of lactic acid increased in 7 days
Control (– mutagen)	7	9.914	1.148	—
1.0×10^{-5} M (+ mutagen)	7	10.045	1.138	(+) 1.321%
2.0×10^{-5} M (+ mutagen)	7	10.152	1.112	(+) 2.400%
3.0×10^{-5} M (+ mutagen)	7	10.380	1.085	(+) 4.700%
4.0×10^{-5} M (+ mutagen)	7	10.520	1.063	(+) 6.112%
5.0×10^{-5} M (+ mutagen)	7	10.750	1.046	(+) 8.432%
6.0×10^{-5} M (+ mutagen)	7	10.965	1.024	(+) 10.601%
7.0×10^{-5} M (+ mutagen)	7	11.165	1.005	(+) 12.618%
8.0×10^{-5} M** (+ mutagen)	7	11.530***	0.989	(+) 16.300%
9.0×10^{-5} M (+ mutagen)	7	10.748	1.116	(+) 8.412%
10.0×10^{-5} M (+ mutagen)	7	10.262	1.135	(+) 3.510%

* 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%

Molasses : 26% (w/v) , Malt Extract: 1.45%
Yeast Extract : 1.45%, Peptone : 1.45%
$(NH_4)_2HPO_4$: 1.45%, $CaCO_3$: 10.0 %
pH : 6.1, Distilled water : To make up 100 ml.
(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[32-33].

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

Strain : *Lactobacillus pentosus* NCIM-2912 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-2912

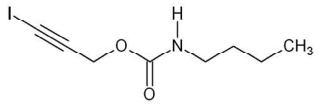
Incubation period : 4, 7 and 10 days

Concentration of iodopropynyl butylcarbamate used :

M/1000 solution of iodopropynyl butylcarbamate under trial has been prepared and 1.0 x 10^{-5}M to 10x 10^{-5} M molar concentration of iodopropynyl butylcarbamate has been employed.

Results and Discussion

The influence of Iodopropynyl butylcarbamate



Iodopropynyl butylcarbamate

The data recorded in the table-1 shows that Iodopropynyl butylcarbamate also has stimulatory effect on mircobial production of lactic acid by *Lactobacillus pentosus* NCIM-2912.

The data (vide table-1) reveals that the chemical mutagen Iodopropynyl butylcarbamate stimulates the mircobial production of lactic acid by *Lactobacillus pentosus* NCIM-2912 and enhances the yield of lactic acid upto its iodopropynyl butylcarbamate concentrations from 1.0 x 10^{-5} to 8.0 x 10^{-5} M. The effect of iodopropynyl butylcarbamate on the productivity (yield) of lactic acid was gradually in increasing order and attains its best role at 8.0 x 10^{-5}M where maximum yield of lactic acid, i.e., 11.530g/100 ml is obtained in 7 days of optimum incubation period which is 16.300% higher in comparison to control fermentor flask, i.e., 9.914 g/100 ml.

In the second phase of mutagenic chemical's effect the molar concentration, i.e., from 9.0 x 10^{-5}M to 10 x 10^{-5}M the mircobial production of lactic acid by *Lactobacillus pentosus* NCIM-2912 has been enhanced but the order of lactic acid productivity is reverse in respect to increasing molar concentrations of iodopropynyl butylcarbamate. However, the mircobial production of lactic acid by *Lactobacillus pentosus* NCIM-2912 under the influence of each concentration of iodopropynyl butylcarbamate used has been stimulating and the yield of lactic acid has been found greater than that obtained in the control fermentor flasks. In both the phases the order of productivity and % of lactic acid formed is as below:

Phase- I

Concentration of iodopropynyl butylcarbamate from 1.0 x 10^{-5}M to 8.0 x 10^{-5}M.

Productivity of lactic acid

1.321%, 2.400%, 4.700%, 6.112% , 8.432%, 10.601%, 12.618% and 16.300%

Phase - II

Concentration of iodopropynyl butylcarbamate from 9.0 x 10^{-5} M and 10.0 x 10^{-5}M.

Productivity of lactic acid:

8.412%, and 3.510%.

Exposure of bacterial strain to iodopropynyl butylcarbamate may produce a variety of effects. Depending upon the concentration of iodopropynyl butylcarbamate to which bacterial strain *Lactobacillus pentosus* NCIM-2912 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.

Thus, it is concluded that iodopropynyl butylcarbamate at lower concentrations is stimulatory and at higher concentrations is deterioratory for mircobial production of lactic acid by *Lactobacillus pentosus* NCIM-2912

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