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Impact of niacinamide on biotic production of lactic acid

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Abstract: The impact of niacinamide on biotic production of lactic acid by some lactic acid producing bacteria such as *Lactobacillus casei* SH-110, *Lactobacillus pentosus* SH-114, *Lactobacillus leichmannii* SH-116, *Lactobacillus delbrueckii* SH-118 and *Lactobacillus acidophilus* SH-120 has been studied. The bacterial strain *Lactobacillus pentosus* SH-114 has been found quite effective and useful for maximum biotic production of lactic acid, i.e,; 7.048 g/100 ml of lactic acid which is 14.359% higher in comparison to control fermentor flasks, i.e,; 6.163 g/100ml at 4 × 1/10000 × 10M molar concentration of niacinamide mutagene. It has been found that biotic production of lactic acid in the presence of niacinamide at optimum molar concentration, i.e.; at 6.0× 1/10000 × 10M attains its best activity when 15% (w/v) molasses solution is allowed to ferment for 6 days of optimum incubation period at 34^{0}C temperature by maintaining the pH value of the fermentation medium at 6.1 along with other nutritional ingredients required by the lactic acid bacteria.

(Keywords: Lactic acid fermentation, niacinamide, molasses, *Lactobacillus pentosus* SH-114, pH, temperature and incubation period.)

Introduction

Environmental impact on biotic systems brings together relevant facts about synthetic and naturally occurring mutagenic chemicals[1-10]. Chemical mutagens induce in the various test systems that have been utilized. Mutation can result in several different types of change in deoxyribo nucleic acid sequences; these can either have no effect, alter the product of a gene, or prevent the gene from functioning properly or completely[11-16]. Mutations can involve large sections of deoxyribo nucleic acid becoming duplicated, usually through genetic recombination. The impact of mutagens in fermentation technology specially lactic acid fermentation has been studied extensively.

Some mutagens were tested by many research workers[17-30] for different fermentations process and were found that most of them were found useful for higher production of the desired products. It is obvious from above review of literature that various chemical mutagens and some other mutagenic agents are used to produce mutants. Thus, it is concluded that a large number of mutagens have been employed to generate the mutatnts of different microbes and microbial process but still there are some chemical mutagens whose impact on biotic production of lactic acid by *Lactobacillus pentosus* SH-114 have not been well studied and established. Moreover, survey of the literature reveals that there has been not enough mention to study the lactic acid fermentation exposed to mutagens specially chemical mutagens. Therefore, in the present investigation the authoress has made an attempt to study the biotic production of lactic acid by *Lactobacillus pentosus* SH-114 exposed to niacinamide.

Experimental

Compositions of the production medium :

The composition of the production medium for the biotic production of lactic acid by *Lactobacillus pentosus* SH-114 exposed to niacinamide is as follows :
Molasses : 15% (w/v), Malt Extract : 1.85%
Yeast Extract : 1.85%, Peptone : 1.50%,
$(NH_4)_2HPO_4$: 1.50%, $CaCO_3$: 7.5%, pH : 6.1

Table - 1
Impact of niacinamide on Biotic production of lactic acid

Concentation of mutagen used a x 1/10000×10M	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 6 days of incubation pd.
Control	2	3.089	4.334	–
(– mutagen)	6	6.163	1.759	–
	10	2.314	1.665	–
1.0 x 1/10000×10M	2	3.129	4.293	–
(+ mutagen)	6	6.247	1.675	+1.362
	10	2.344	1.569	–
2.0 x 1/10000×10M	2	3.156	4.266	–
(+ mutagen)	6	6.302	1.620	+2.255
	10	2.364	1.517	–
3.0 x 1/10000×10M	2	3.220	4.210	–
(+ mutagen)	6	6.434	1.489	+4.397
	10	2.413	1.387	–
4.0 x 1/10000×10M	2	3.292	4.135	–
(+ mutagen)	6	6.571	1.351	+6.620
	10	2.466	1.311	–
5.0 x 1/10000×10M	2	3.394	4.029	–
(+ mutagen)	6	6.777	1.145	+9.962
	10	2.543	1.119	–
6.0 x 1/10000×10M**	2	3.530	3.892	–
(+ mutagen)	6	7.048***	0.879	+14.359
	10	2.637	0.798	–
7.0 x 1/10000×10M	2	3.360	4.069	–
(+ mutagen)	6	6.708	1.215	+8.843
	10	2.517	1.198	–
8.0 x 1/10000×10M	2	3.258	4.164	–
(+ mutagen)	6	6.503	1.419	+5.516
	10	2.441	1.399	–
9.0 x 1/10000×10M	2	3.190	4.234	–
(+ mutagen)	6	6.370	1.559	+3.358
	10	2.390	1.517	–
10.0 x 1/10000×10M	2	3.116	4.310	–
(+ mutagen)	6	6.223	1.699	+0.973
	10	2.339	1.595	–

* Each value shows mean of three observation ** Optimum concentration of mutagens under observation *** Maximum prodution of lactic acid (LA) Positive Values indicate percent enhancement in the production of $CH_3CHOHCOOH$ Experimental deviation $\pm$ 2.5 – 3.5%

(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[32] formed and molasses[33] left unfermented was made colorimetrically.

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

Strain : *Lactobacillus pentosus* SH-114 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* SH-114.

Incubation period : 2, 6 and 10 days

Concentration of niacinamide used :

M/1000 solution of niacinamide under trial has been prepared and 0.1 x 1/10000×10M to 0.1 x 1/10000×10M 1/10000 molar concentration of niacinamide has been employed.

Results and Discussion

The data recorded in the table 1 shows that niacinamide has stimulatory effect on biotic production of lactic acid by *Lactobacillus pentosus* SH-114

The maximum yield of lactic acid, ie; 7.048g/100 ml in the presence of niacinamide was observed at 6.0 x 1/10000×10M molar concentration in 6 days of optimum incubation period which is 14.359% higher in comparison to flat bottom control fermentor flasks, i.e.; 6.163g/100 ml in the same times course and other same experimental parameters.

The higher molar concentrations of niacinamide were not much favourable for the biotic production of lactic acid by *Lactobacillus pentosus* SH-114. So the gradual addition of the mutagen niacinamide after certain concentrations were not beneficial for the lactic acid fermentation bioprocess.

It has been observed that molar concentration of the mutagen, i.e., niacinamide from 1.0 x 1/10000×10M to 6.0 x 1/10000×10M enhances the yield of lactic acid to a certain order being 1.362%, 2.255%, 4.397%, 6.620%, 9.962% and 14.359% higher in comparison to control flat bottom flasks but at 7.0 x 1/10000×10M and 8.0 x1/10000×10M the yield of lactic acid shifted to be 8.843% and 5.516% higher in comparison to previous concentrations of niacinamide taken into experimental trials.

It has been observed further that after optimum concentration, i.e., 6.0 x 1/10000×10M, the addition of the same mutagen to the production medium causes fall in the yield of lactic acid gradually and reaches to 0.973%; However, at all the experimental concentrations of niacinamide used the yield of lactic acid by submerged fermentation has been found higher in comparison to flat bottom control fermentor flasks.

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