

“Biosynthesis of lactic acid in SMF system by facultative aerobe exposed to some Electrolytes”

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Abstract

*In the present investigation “Biosynthesis of lactic acid in SMF system by facultative aerobe exposed to some Electrolytes” I observed the effect of various physiologically important electrolytes $MgSO_4$, NaCl, KCl and Na-citrate, taken separately and in combination, on lactic acid product by *L. Bulgaricus* MG. To study the influence of mixed electrolytes, a solution was prepared by dissolving 0.588 g $MgSO_4$ 0.292 g NaCl. 1.8696 g KCl, 1.471g sodium citrate, and 0.780 g sodium hydrogen phosphate (diabasic) in distilled water and the volume of the solution was made up-to one litre. It has been found that metallic cations individually have not any marked effect on lactic acid fermentation by *L. bulgancus* - MG however, in the presence of mixture of electrolytes the bacterial activity of producing lactic acid is markedly increased.*

Keywords: *L. bulgancus – MG, electrolytes, $MgSO_4$, NaCl, KCl and Na-citrate,*

Introduction

Biosynthesis is a multi-step, enzyme catalyzed process where substrates are converted into more complex products in living organisms. In biosynthesis, simple compound are modified, converted into other compounds, or joined together to form macromolecules. This process often consists of metabolic pathway. The importance of minerals in microbial nutrition received its first emphasis when Pateurfoudn that the addition of ah was necessary before yeasts would grow on a medium containing ammonium salts and sucrose. Somewhat later, the importance of minerals in plant and animal nutrition became evident, but studies on role of minerals in microbial life has lagged because procedures for purification and detection of metabolites have not been sensitive enough to cope with minute quantity of ions, ordinarily required by the bacteria.

Experimental

General experimental methods" contains the chemical cleaning and steam sterilization of glasswares and different fermentation medium broth, preparation of culture and production medium and also buffer solution, seeding of culture tubes and inoculation of production medium, incubation of culture tubes and production medium colourimetric determination of lactic acid formed by *Lactobacillus bulgaricus*-MG and molasses sugars left unfermented during the course of present investigation biosynthesis of lactic acid in SmF system by facultative aerobe.

Fifty four flasks containing the fermentation medium (Prepared as described in chapter -2) were sterilized. These were divided into six sets. 2% (w/v) solution of the electrolyte (MgSO_4 , NaCl, KCl and Na-citrate separately) was prepared and 1,2,3,4 and 5 ml of this solution were added in the flasks of 1st, 2nd, 3rd, 4th and 5th sets respectively.

The flasks of sixth set were kept as control. To study the influence of mixed electrolytes, a solution was prepared by dissolving 0.588 g MgSO_4 0.292 g NaCl. 1.8696 g KCl, 1.471g sodium citrate, and 0.780g sodium hydrogen phosphate (diabasic) in distilled water and the volume of the solution was made up-to one litre. All the flasks were inoculated with culture of *L. bulgaricus* strain MG, incubated at 47° , the pH being maintained between 5.8-6.0 with CaCO_3 , and analysed after 2, 4 and 6 days of incubation for lactic acid (produced) and sugar (left unfermented).

Result and Discussion

The results of the colorimetric analysis are given in table 1 - 5. The values reported are the mean values of three observations in each case.

Table - 1

Fermentation production of lactic acid in presence of MgSO_4

S. No.	Quantity of Solution of MgSO ₄ Added	Yield of lactic acid g/100ml*			Sugar left unfermented g/100ml*		
		2 days	4 days	6 days	2 days	4 days	6 days
1	1 ml	1.07628	1.80236	2.00356	3.17563	2.28892	2.19623
2	2 ml	1.10236	1.95632	2.08596	3.03569	2.20256	2.10236
3	3 ml	1.07256	1.67256	2.10236	3.15265	2.43569	2.09865
4	4 ml	1.10123	1.62356	2.05126	3.09156	2.40236	2.13256
5	5 ml	1.10236	1.60236	2.06456	3.11265	2.47568	2.13256
6	Control	1.01789	1.50236	1.97261	3.20266	2.60259	2.21102

*Each value represents the mean of three trails.

Experimental deviation $\pm 1.5 - 3\%$

Table -2

Fermentation production of lactic acid in presence of NaCl

S. No.	Quantity of Solution of NaCl Added	Yield of lactic acid g/100ml*			Sugar left unfermented g/100ml*		
		2 days	4 days	6 days	2 days	4 days	6 days
1	1 ml	1.02143	1.51265	1.97265	3.22486	2.47623	2.21169
2	2 ml	1.00154	1.51265	2.00235	3.24569	2.49265	2.18456
3	3 ml	1.05158	1.52694	1.98254	3.15264	2.46581	2.19456
4	4 ml	1.07456	1.49586	1.99254	3.26543	2.52466	2.19457
5	5 ml	0.98456	1.50265	1.96256	3.23256	2.51265	2.22156
6	Control	1.00256	1.47265	1.95683	3.22156	2.56244	2.3156

*Each value represents the mean of three trails.

Experimental deviation $\pm 1.5 - 3\%$

Table – 3

Fermentation production of lactic acid in presence of KCl

S. No.	Quantity of Solution of KCl Added	Yield of lactic acid g/100ml*			Sugar left unfermented g/100ml*		
		2 days	4 days	6 days	2 days	4 days	6 days
1	1 ml	1.01123	1.52365	1.96265	3.24256	2.55265	2.20236
2	2 ml	1.03256	1.49256	1.98265	3.20265	2.60256	2.16252
3	3 ml	1.07256	1.55265	1.98260	3.24256	2.50265	2.17256
4	4 ml	1.02565	1.53654	1.99526	3.26565	2.49562	2.14265
5	5 ml	1.10235	1.54265	2.00235	3.17265	2.48562	2.11265
6	Control	1.00236	1.50235	1.96523	3.23256	2.58262	2.22365

*Each value represents the mean of three trails.

Experimental deviation $\pm 1.5 - 3\%$

Table – 4

Fermentation production of lactic acid in presence of Na-citrate

S. No.	Quantity of Solution of KCl Added	Yield of lactic acid g/100ml*			Sugar left unfermented g/100ml*		
		2 days	4 days	6 days	2 days	4 days	6 days
1	1 ml	1.05265	1.49562	1.96236	3.25463	2.55692	2.22362
2	2 ml	1.01265	1.51265	1.94235	3.27156	2.52360	2.19265
3	3 ml	1.00232	1.52365	1.97283	3.27189	2.55146	2.18562
4	4 ml	1.03265	1.51235	1.96253	3.21456	2.50123	2.21265
5	5 ml	1.02366	1.50236	1.92584	3.24156	2.57159	2.20365
6	Control	1.01236	1.50236	1.95436	3.24158	2.53263	2.23215

*Each value represents the mean of three trails.

Experimental deviation $\pm 1.5 - 3\%$

Table – 5

Fermentation production of lactic acid in presence of mixed electrolytes

S. No.	Quantity of Solution of mixed electrolyte Added	Yield of lactic acid g/100ml*			Sugar left unfermented g/100ml*		
		2 days	4 days	6 days	2 days	4 days	6 days
1	1 ml	1.10235	1.50265	1.98162	3.11235	2.60325	2.19456
2	2 ml	1.12564	1.55265	2.00236	3.10235	2.55265	2.18565
3	3 ml	1.12365	1.56236	2.10236	3.11256	2.44562	2.09544
4	4 ml	1.13654	1.60235	2.12323	3.10235	2.40235	2.08568
5	5 ml	1.10235	1.70135	2.16352	3.13235	2.36546	2.05654
6	Control	1.00235	1.48562	1.94256	3.23213	2.57165	2.24660

*Each value represents the mean of three trails.

Experimental deviation $\pm 1.5 - 3\%$

Discussion

The results obtained in present investigation are of great significance. It has been concluded that cations like Mg^{++} , Na^+ , K^+ individually in concentration between 0.02-0.1% have not any marked effect on lactic acid fermentation by *L. bulgaricus* MG when molasses is employed as substrate. However, in the presence of mixture of electrolytes the bacterial activity of producing acid is markedly increased.

Results of table- 4 show the effect of $MgSO_4$ on the activity of *L. bulgaricus* MG. It is seen that at concentrations between 0.20-0.1%, Mg^{++} stimulated bacterial activity of producing acid, 0.06% concentration being most favourable which gave a maximum yield (47.33% of total sugar in comparisons to 44.79% of control experiment) of lactic acid.

The data recorded in table- 5 represent the effect of NaCl on the activity of bacteria. It is evident that presence of Na^+ in fermentation medium from 0.02-0.1% concentration is not harmful for bacterial activity. Instead a slight increase in the yield of lactic acid has been obtained at all the experimental concentrations of NaCl. At 0.4% concentration maximum increase in the yield of lactic acid has been obtained (about 45.4% yield of lactic acid in comparison to 44.3% of control of total sugar).

The effect of KCl on *L. bulgaricus* MG can be compared with the effect produced by NaCl. Like Na^+ , K^+ also, at all the experimental concentrations, either gave a favourable response to the acid producing activity of bacteria or remained un-effective. A very slight increase in the yield of lactic acid has been noted at 0.1% concentration of KCl (ed. table - 4)

Sodium citrate has no effect on the acid producing activity of *L. bulgaricus* MG, when present in fermentation medium between 0.02-0.1% concentration. It is evident from the results of table 5

that at experimental concentrations of sodium citrate, the yield of lactic acid is approximately equal to the yield which has been obtained in the absence of sodium citrate i.e. in control.

However, the complex mixture of electrolytes, at all the concentration used in the experiment, has a marked and favourable effect on the acid producing activity of the bacteria. As is clear from Table -5 there is gradual increase in the production of lactic acid with increase in the concentration of mixed electrolytes. Maximum acid has been produced at 5 mi concentration of mixed electrolytes which is more (49% of total sugar) than that in the control (44.5%)

It was also observed that about 91% of the consumed sugar was converted into lactic acid in presence of electrolytes (mixed). This is comparable to the amount of sugar being fermented into acid in the control experiment.

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