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Effect of magnetic field on the biosynthesis of neomycin by *Streptomyces marinensis*

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The effect of 30, 70, 90, 100, 110 and 150 gauss permanent magnetic field strength on the growth and neomycin titre of *Streptomyces marinensis* was studied. Maximum growth was attained in 120 h at all magnetic strengths. Gradual increase in neomycin titre was observed with increase of magnetic field strength up to 110 gauss.

1. Introduction

Reports are available in the literature on the varied effects of magnetic field strengths on biological specimens. The effect of magnetic stimulus on the growth and development of higher plants has been studied [1, 2]. This stimulus has also been observed to affect microbial growth [3, 4] while a high electromagnetic field (50,000 gauss) has been used for drastic reduction of microbial populations [5]. Kimball [6] and Jensen [7] observed some changes in morphology and spore formation in yeasts, bacteria and moulds under the influence of a strong magnetic field. Chauhan [8] studied the effect of electromagnetic field on the fermentation capacity of yeast cells and obtained enhanced alcohol production in a shorter period. There are almost no reports on the study of the effect of magnetic field on the growth of *Streptomyces* and the biosynthesis of their secondary metabolites. It has also been reported that the application of magnetic fields of 300–500 gauss over a pain trigger point resulted in significant and prompt relief of pain in postpolio patients [9]. The present investigation deals with a study of the effect of magnetic field on the growth and neomycin production of *S. marinensis*.

2. Investigations, results and discussion

The results are presented in the Table. In all the experiments (at different magnetic strengths), the maximum PCV (packed cell volume) was obtained at 120 h and the PCV decreased on further incubation. As the magnetic field strength increased, PCV content also increased. Moore [4] also obtained similar results (maximum growth stimulation at 150 gauss) with bacteria and yeast. There was a gradual rise in pH value up to 144 h where it was stabilized. The overall assessment of PCV and pH data indicated that the rate of growth and metabolism of the organism are higher under the influence of a magnetic field than for the control (Table). There was a gradual increase in the biosynthesis of antibiotic with increasing of magnetic field strength up to 110 gauss while there was some decrease in antibiotic titre at 150 gauss. The results indicate an enhanced neomycin titre of 7%, 15%, 21%, 30% and 83% (over the control) for 30, 70, 90, 100 and 110 gauss strengths respectively. Vonzaya [10] stated that the concentration of dissolved oxygen increases in magnetically treated water. It is well known that microorganisms producing secondary metabolites are highly aerobic and

Table: Effect of magnetic field on pH, growth and neomycin titre by *S. marinensis*

Magnetic field strength (gauss)	Incubation time											
	72 h			96 h			120 h			144 h		
	pH	PCV	U/ml	pH	PCV	U/ml	pH	PCV	U/ml	pH	PCV	U/ml
Control	7.1	1.2	250	7.4	1.6	410	7.8	1.65	730	8.0	1.5	1875
30	7.2	1.25	380	7.5	1.65	530	7.85	1.7	770	8.1	1.5	2000
70	7.2	1.3	400	7.6	1.7	620	7.9	1.75	810	8.2	1.6	2160
90	7.25	1.4	430	7.65	1.8	730	8.0	1.85	860	8.3	1.7	2275
100	7.3	1.45	530	7.7	1.9	780	8.1	2.0	930	8.4	1.9	2440
110	7.4	1.6	590	7.8	2.0	810	8.2	2.2	1230	8.4	2.0	3430
150	7.4	1.5	571	7.8	1.9	798	8.2	2.1	1192	8.4	2.0	3045

The results are average values of four batches
PCV: Packed cell volume
U/ml: Units/ml
Control: Without magnet

the productivity is related to dissolved oxygen concentration up to a certain limit.

3. Experimental

3.1. Method of application of magnetic field

Six types of permanent magnet with magnetic field strengths of 30, 70, 90, 100, 110 and 150 gauss were employed (throughout the fermentation cycle). Each magnet was placed beneath the production flask on the rotary shaker. To prevent contact of the production flask with the base plate of the shaker which is iron, 5 cm thick wooden blocks were placed between the magnet and the base of the rotary shaker. A control was also run without the application of a magnetic field.

3.2. Fermentation

The culture used in this work was a new neomycin producing streptomycete, *Streptomyces marinensis* [11, 12]. It was maintained on jowar starch agar. A two stage fermentation was carried out in all the experiments for which the inoculum was prepared in a seed medium containing 2.5% soluble starch, 1% corn steep liquor (CSL), 0.5% $(NH_4)_2SO_4$, 0.5% $CaCO_3$ and pH 7.0. The seed medium (50 ml in 250 ml flask) was inoculated with spore suspension from a slant (7 days old) and incubated on a rotary shaker (220 rpm) at 28 °C for 48 h. A 10% level of inoculum was transferred to a production medium (50 ml in 250 ml flask) with the following composition: 9% dextrin, 2% soybean meal, 1% sesame meal, 1% CSL, 1% $(NH_4)_2SO_4$ and 1% $CaCO_3$ with pH 7.0. The production flasks (under the influence of the magnetic field) were incubated on a rotary shaker for 144 h at 28 °C. Samples were withdrawn at every 24 h from 72 h onwards and analyzed for PCV, pH and neomycin titre of the broth. The PCV was determined by centrifuging samples at 3000 rpm for 15 min. The pH of clear broth was recorded with a pH meter. Neomycin content was estimated by the conventional cup-plate method [13, 14] using *Bacillus pumilus* NCIM 2327 as the test organism.

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