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Impact of rubber industry effluent on the amino acid and fatty acid content of cyanobacteria

Perumal Senthil , Savarimuthu Jeyachandren, Chocckaya Manoharan and *Subramaniyan Vijayakumar

P.G. and Research Department of Botany & Microbiology, A.V.V.M. Sri Pushpam College (Autonomous), Poondi, Thanjavur District, Tamilnadu, India

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ABSTRACT

The present study is aimed at finding out the impact of rubber industry effluent on the, amino acid and fatty acid contents of two cyanobacteria for the purpose , Oscillatoria salina and Micocystis aeruginosa were chosen as the test organism. Altogether 16 different amino acids and 24 different fatty acids were detected in both test organisms. Some of the amino acids and fatty acids found in control were not detected from the effluent grown cyanobacteria and vice versa. However, cyanobacteria grown in effluent recorded higher quantity of total amino acids and fatty acids when compared to control. The variation in their quantity and quality has been discussed.

Key words: Rubber effluent, Cyanobacteria, Amino acid and Fatty acid.

INTRODUCTION

Cyanoobacteria have a great deal of potential as source fine chemicals, as a biofertilizer and as a renewable fuel [9]. Recently, there has been increasing awareness about using cyanobacteria as bioremediation and pollution control agents, because they are environmental friendly and do not cause toxicity in other biotic components and their biomass production is in abundance and this can be used as a feed for animals, food industries, biotechnological applications and pharmacy industries[11, 20 and 21]. Now a day, Scientists interested in the use of algal or cynobacterial systems have concentrated on the removal of nutrients from the effluents, but only few have investigated [3, 12 and 22] the effect of effluents on the physiology and biochemistry of cyanobacterial systems. To develop suitable and efficient system, it is obligatory to understand the mutual influence and interaction between the organisms and effluent, so that manipulations to improve treatment systems become feasible. Hence, the present work was carried out; to study the biochemical characteristics such as amino acid and fatty acid content of effluent grown cyanobacteria were investigated.

MATERIALS AND METHODS

Rubber effluent was collected from Nijavalli latex, situated at Cochin, Kerala, India. Physico-chemical analysis of the effluent was carried out according to standard methods [2]. Cyanobacteria such as *Oscillatoria salina* Biswas and *Microcystis* aeruginosa (kutz) were collected from the same place from where the effluent was collected; made

unialgal in laboratory and maintained in BG 11medium [16]. For the treatments, Erlenmeyer flasks (250 ml) were used cyanobacteria were grown in effluent (treatment) and BG 11 medium (control) till the experimental growth period under controlled conditions (temperature maintained at 28+ 2 c filled with cool white fluorescence tubes emitting 2500 lux for 18 hours a day). Cyanobacterial samples were harvested by centrifugation and used for biochemical studies. Amino acids and fatty acid profiles were carried out following the methods [13 and 15] respectively.

RESULTS AND DISCUSSION

Amino acid profile of cyanobacteria is given in the Table 1. Totally 16 different amino acids were detected from *Oscillatoria* and *Microcystis*. Among the Cyanobacteria, *Oscillatoria* grown in BG II medium (C1) recorded 15 different amino acids while *Microcystis* in the same conditions showed only 11 (Table 1) . Similarly *Oscillatoria* (t1) and *Microcystis* (T2) grown in effluent showed 11 and 12 respectively. Amino acids such as serine, glycine, prolein and lysine recorded inC1, were not detected from T1. On the other hand valine detected from T1 was not recorded in C1. Phenylalanine and proleine detected in T2 were not recorded in C2. Similarly lysine recorded in C2 was not5 detected from T2. Of the amino acids, the level of histidine and arginine was found to be highest in both *Oscillatoria* and *Microcystis* in all treatments (Table1). Amino acids such as glutamic acid, histidine, Arginine, Tyrosine, Methionine and phenylalanine were recorded with increase in their content in T1 over C1. Similarly Glutamic acids, Asparagine, Arginine, Tyrosine and Methionine were higher in their content in T2 over C2. In general, the total quantity of amino acids was high in T1 and T2 over their C1 and C2.

Similarly, [22] reported an increase in amino acids levels not only quantity but also quality when *Oscillatoria* and *Westiellopsis* treated with Dye effluent. Contrary to this observation [3] reported a decrease in the level of amino acids in both qualitative and quantitative when *Oscillatoria* and *Aphanocapsa* treated with dairy effluent. Various amino acids reported in the present study have already been reported by various workers [5, 8 and 12]. [17] Found arginine as the dominant aminoacid in *Phormidium uncinatum* followed by hisditine, lysine leusine and α-alanine in fairly good quantity. However, in the present investigation it was found that hisditine was dominant in both *Oscillatoria and Microcystis* which is followed by arginine, aspirate, asparagines, glutamine and so on (Table 1). Similar observation with higher content of hisditine has already been reported [3 and 22]. A noteworthy observation, most of the amino acids recorded in T1 and T2 showed higher in their content over C1 and C2. Similarly, some of the amino acids detected effluent grown *Microcystis* were not detected in control (grown in BG11 medium). Hence comparison with results obtained with other cyanobacteria is neither feasible nor possible. This may be concluded that the observations in amino acids in the present case might be due to effluent stress.

Generally lipids of cyanobacteria are esters of glycerol and fatty acids. They may be either saturated or unsaturated. Totally 24 fatty acids (both saturated and unsaturated) were detected from both cyanobacteria. Altogether 20 fatty acids from *Oscillatoria* (C1 and T1) and 19 from *Microcystis* (C2 and T2) were recorded (Table 2). Among the treatments C1 and T1 recorded 15 and 16 fatty acids respectively, while C2 and T2 observed with 17 and 15 respectively. Though, the number of fatty acids in T2 was less than that of C2, the total quantity was more in T2 as compared to C2. These include, short chain, long chain, saturated and unsaturated fatty acids. This confirms the earlier findings of [3 and 22]. In the present study, long chain fatty acids such as behenic, linoceric and unsaturated fatty acids g-linilenic and linoleic acid were detected from T1 and not in C1. Similarly, in C2 lignoceric was not recorded which could otherwise detected in T2. Moreover in both T1 and T2 most of the unsaturated fatty acids, particularly g-linolenic acid, were recorded significantly with higher levels. Environmental and nutritional conditions leading to enhanced production of unsaturated fatty acids particularly linolenic acid has been reported in microalgae [3, 4 and 12].

Most of the fatty acids in cyanobacteria pertain to long chain fatty acids [1, 6, 7, 10 and 14]. However, [8, 12, 18 and 22] reported the occurrence of short chain fatty acids. In the present investigation, short chain fatty acids such as capric and undecanoic acid from *Oscillatoria* (control) and Tridecanoic acid in all treatments were detected. Considerable and significant changes in the levels of fatty acids, under different environmental conditions such as light and dark [1], aerobic and anaerobic conditions [7, 14 23, 24, 25, 26 and 27], Salinity [19] and with different effluents [3, 12 and 22] have already been reported. From the above discussion, it is concluded that, rubber effluent significantly influencing the biochemical constituents of cyanobacteria by both qualitatively and quantitatively. A

significant increase in the level of some essential amino acids and unsaturated fatty acids needs to be further studied in order to exploit them commercially.

Table 1. Qualitative and quantitative analysis of amino acids in *O. salina* and *M. aeruginosa* (mg g^{-1} dry wt)

Amino acids	C1	T1	C2	T2
Aspartic acid	36.28	24.06	42.14	20.44
Glutanic acid	14.68	23.87	15.16	18.60
Asparagine	26.42	14.52	18.72	21.25
Serine	08.71	-	24.70	08.66
Glutamic	17.13	12.61	21.72	13.37
Histidine	86.08	97.01	62.72	50.28
Glysine	04.83	-	-	-
Arginine	58.42	67.19	41.88	56.07
Alanine	03.88	-	-	-
Tyrosine	12.47	19.62	21.36	25.14
Valine	-	04.23	02.42	21.42
Methionine	16.97	33.29	09.82	29.03
Phenylalanine	07.33	15.30	-	02.14
Proleine	04.67	-	-	04.68
Leucine	15.48	08.32	-	-
Lysine	01.72	-	04.71	-
Total level	315.07	320.02	264.81	271.08

(-) – Not detected, C1- Oscillatoria grown in BG11 medium, T1 – Oscillatoria grown in effluent, C2- Microcystis grown in BG11 medium, T2- Microcystis grown in effluent

Table 2: Qualitative and quantitative analysis of fatty acids in *O.salina* and *M.aeruginosa* (mg g^{-1} of lipids)

Name of the fatty acids		C1	T1	C2	T2
Capric acid	(C10:0)	0.8922	-	-	-
Undecanoic acid	(C11:0)	0.7193	-	-	-
Lauric acid	(C12:0)	3.0341	-	1.8162	-
Tridecanoic acid	(C13:0)	1.8431	2.3141	1.4130	1.2141
Pentadecanoic acid	(C15:0)	-	1.9472	-	-
Palmiti acid	(C16:0)	1.4562	3.4201	-	0.5620
Heptadecanoic acid	(C17:0)	2.1612	2.6174	0.2861	2.3897
Heneicosanoic acid	(C21:0)	0.8641	3.6123	-	-
Behanic acid	(C22:0)	-	0.8271	0.0120	0.8621
Lignoceric acid	(C24:0)	-	0.0182	-	1.0057
Pentacosanoic acid	(C25:0)	-	-	2.8234	-
Myristoleic acid	(C14:1)	0.3068	4.6753	0.3197	0.064
Palmitioleic acid	(C16:1)	3.5462	5.2124	0.2021	0.8621
Elaidic acid	(C18:1 trans)	0.4621	0.6829	0.0401	0.1231
Oleic acid	(C18:1 Cis)	1.2931	1.8620	0.0046	0.5128
Linolelaidic acid	(C18:0)	1.2461	0.7623	0.8621	0.1427
Linoleic acid	(C18:2 Cis)	-	1.8841	-	-
G-Linolenic acid	(C18:3 Cis)	-	0.3768	0.0081	1.4361
Eicosenoic acid	(C20:1)	1.8630	3.5306	0.2461	1.8690
Eicosadienoic acid	(C20:2)	-	-	0.6429	-
Eicosapentaenoic acid	(C20:0)	-	-	3.0631	0.8621
Arachidonic acid	(C20:4)	0.8526	-	0.7117	-
Docosahexaenoic acid	(C22:6)	0.7261	1.2610	1.8421	2.0410
Nervonic acid	(C24:1)	-	-	0.7261	2.1614

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