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ÇEKMECE NUCLEAR RESEARCH AND TRAINING CENTER
İSTANBUL - TURKEY

ÇNAEM-R- 212

THE USE OF MICROBIAL PROTEINS FOR THE CULTIVATION OF PHYTOPLANKTON CULTURE

Sayhan TOPÇUOĞLU and Mustafa ÖZYURT

P.K. 1, Hava Alanı, İstanbul, Turkey
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Fitoplankton Kültürü Yetiştirilmesinde Mikrobiyal Proteinlerin Kullanılması

Özet. Günümüzde ekonomik önemi olan bazı deniz organizmalarının larvalarını beslemede fitoplankton kültürleri kullanılmaktadır. Denizlerdeki besin zincirinin ilk halkasını oluşturan fitoplanktonların, çeşitli türlerinden oluşan kültürler laboratuvarımızda mevcuttur. Mikrobiyal proteinlerin besin olarak bazı canlılara verilmesine yönelik bir çok çalışma vardır. Çeşitli mikrobiyal proteinler de laboratuvarımızda üretilmektedir. Bu araştırmanın amacı büyük miktarlarda fitoplankton kültürünün mikrobiyal proteinler kullanarak, en kolay ve en ekonomik yönden elde edilebileceğini kanıtlamaya yöneliktir. Sonuç istenilen amaçda neticelenmiştir.

The use of microbial proteins for the cultivation of phytoplankton culture

Summary. The effect of the microbial proteins on the growth rate of Phaeodactylum tricornutum in the mass cultures have been investigated. The results were evaluated both as optical density and the number of the phytoplankton cells. The microbial proteins have caused a phytoplankton density which was the same with that of the control group.

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Introduction

The cultivation of phytoplankton has been studied in large amounts as mass cultures (Davis and Ukeles, 1961; Ansell et al., 1964). These organisms are being used as food for larvae of some marine animals which may have economical importance. Phytoplankton cultures are being cultivated in some laboratories to investigate many pollution problems because they are highly sensitive against the pollutants (Ukeles, 1962; Topçuoğlu, 1973) and can accumulate some metals in their bodies up to high concentrations.

In previous papers, wastewater and sediments containing some pollutants have been used as nutrient sources for cultivation of phytoplankton (Goldman and Stanley, 1974; Golterman, 1977). In this way, relatively large quantities of phytoplankton can be cultivated.

The vitamine requirements of most of phytoplankton species were known, but knowledge of their ability to grow on organic carbon sources and their ability to utilize different nitrogen sources was fragmentary (Turner, 1979).

The use of microbial proteins (single cell protein) for animal feeding have been investigated in many studies (Shacklady, 1970; Smith et al., 1975). The amino acids in the protein contents of microbial proteins may be significant carbon and nitrogen sources and the micro-

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bial proteins include also some trace elements and vitamins (North and Stephens, 1967; Pepler, 1967) In this respect we can hope the positive effect of microbial proteins on growth rate of phytoplankton. In this study, the effect of microbial proteins on the cultivation of Phaeodactylum tricornutum was investigated.

Materials and Methods

Phytoplankton. Phaeodactylum tricornutum Bohlin, was used in the study. This species was obtained from the Institute of Villefranch-sur-Mer (France).

Culture of Phytoplankton. Mass culture of this species was prepared by inoculation of each liter of sea water with 5 ml of bacteria-free unialgal stock culture. The sea water was taken from Marmara Sea (salinity 19.4 ppt). It was filtered through cotton, kept at 100 ^{o}C in an oven and than used in the experiment. The tests were conducted using 3 liter of sea water in plastic bags. These bags were kept as hanged and continously aerated in the cultivation room. The composition of the enrichment solution was as follows: KNO_3 5 g, K_2HPO_4 0.5 g, $MnSO_4.4H_2O$ 16.5 mg, Na_2EDTA 1 g, thiamine 5 mg, B_{12} 0.05 mg and distilled water 50 ml. 1 ml of this solution was added to 1 liter of sea water.

Microbial Proteins. Aspergillus niger M1 (AS 21 M1), Candida utilis var. major (YTO 34) and Torulopsis magnoliae (Ye) were used. These microbial proteins were produced on olive waste by shake-flask fermentation as mentioned in a previous work (Özyurt, 1975). The microbial proteins were added to sea water (0.5 g/l). In these tests of the study the other nutrients were not added with the microbial proteins. This concentration and the species of microbial protein have been chosen from a preliminary study.

Growth Tests. The culture room has been affected by daylight beside under illumination by white fluorescent lamps giving a light intensity of 840 lux at the surface of the bags. In a work on the effect of temperature on Phaeodactylum tricornutum, it has been indicated that

maximal cell density was achieved to a maximum at 20 °C (Goldman, 1977). Therefore, we worked at the same temperature. The results were evaluated both as optical density (by Beckman DU spectrophotometer) and the number of phytoplankton cells in 0.1 mm^3 (using a haemocytometer). The samples for counting were taken from the test media after homogenizing by a magnetic mixer.

Results

Effects of Microbial Proteins on the Growth of *Phaeodactylum tricornutum*. The microbial proteins used in our work have caused the growth rate of *Phaeodactylum tricornutum* which were the same with that of the control group (with enrichment solution) as shown in Fig. 1. It is apparent that

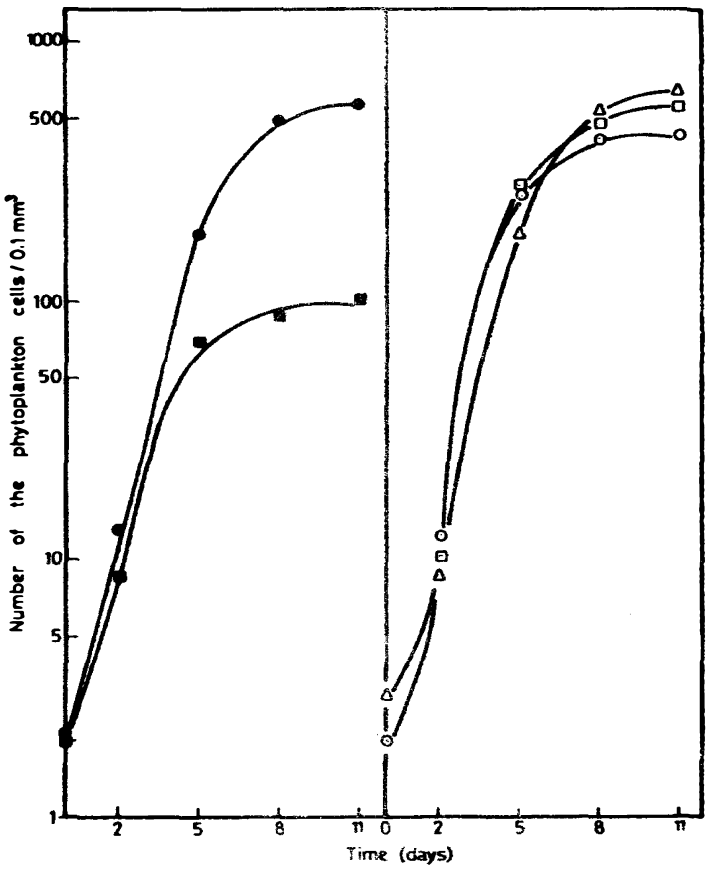

Fig.1. Effect of the microbial proteins on the growth rates of *Phaeodactylum tricornutum*. (●), sea water + enrichment for the phytoplankton culture; (■), sea water; (▲), sea water + AS 21 M1; (□), sea water + YTO 34; (○), sea water + Ye

the best growth of the phytoplankton was affected with AS 21 M1. The cell number in the group containing only sea water has been found considerably less than those of the other groups. On the other hand, the same result

was obtained from the measurement of optical density (Table 1).

Table 1. The growth rate of Phaeodactylum tricornutum in different media. Growth is expressed as the optical density[a]

Time (days)	Sea water	Sea water + Enrichment solution	Sea water + AS 21 M1	Sea water + YTO 34	Sea water + Ye
0	0.005	0.002	0.091	0.147	0.064
2	0.010	0.020	0.114	0.091	0.147
5	0.064	0.252	0.319	0.335	0.337
8	0.079	0.580	0.724	0.668	0.634
11	0.070	0.685	0.821	0.709	0.605

[a]All optical density values do not include the zero values

Discussion

It is already known that the dissolved and the soluble organic compounds have nutritive potential for phytoplankton (North et al., 1972). North and Stephens (1967) have reported that amino acids could be significant carbon and nitrogen sources as a result of their work with glycine on Platymonas phytoplankton species. The microbial proteins which we used in our work contain about 25 % protein of which glycine approximately 5 % (Özyurt, 1977). The amino acids in the microbial proteins added into test medium can partly be dissolved and partly change to particular form.

Some B group vitamins (particularly thiamine and B_{12}) and mineral solution are present in the composition of culture medium prepared for the phytoplankton (Provasoli et al., 1957). Ansell et al. (1963) have indicated that the population density increased with the addition of trace elements to the culture medium of Phaeodactylum tricornutum. It can be considered that the microbial proteins which we used in our work should include some trace elements and vitamins such as thiamine since it has been mentioned in those works carried out on microbial protein composition (Diez and Ursinos, 1961; Peppler, 1967).

From the results above we can conclude that the microbial proteins can be used for phytoplankton growth.

References

Ansell, A.D., Raymont, J.E.G., Lander, K.F. (1963). Limnol. Oceanog. 8, 207-213

Ansell, A.D., Coughlan, J., Lander, K.F., Lossmore, F.A. (1964). Limnol. Oceanog. 26, 334-342

Davis, H.C., Ukeles, R. (1961). Science 134, 562-564

Diez, M.J.F., Ursinos, J.A.F. (1961). Grasas y Aceites 12, 161-165

Goldman, J.C., Stanley, H.I. (1974). Mar. Biol. 28, 17-25

Goldman, J.C. (1977). Limnol. Oceanog. 8, 932-936

Golterman, H.L. (1977). Proc. Int. Symp. 6-10 Sept. Amsterdan 286-293

North, B.B., Stephens, G.C. (1967). Biol. Bull. 133, 391-400

North, W.J., Stephens, G.C., North, B.B. (1972). In: Marine pollution and sea life, M. Ruivo, eds., pp. 96-121. London: Fishing News

Özyurt, M. (1975). Ç.N.A.E.M. Rep. Seri 144 Istanbul

Özyurt, M. (1977). Ç.N.A.E.M. Rep. Seri 167 Istanbul

Peppler, H.J. (1967). Yeast technology. In: Microbial technology, H.J. Peppler, eds., pp. 121-162. New York, Amsterdam: Reinhold Press

Provasoli, L., Mclaughlin, J.J.A., Droop, M.R. (1957). Arch. Mikrobiol. 25, 392-428

Shacklady, C.A. (1970). Presented at the 3rd Int. Cong. of food Sci. and Tech. 9-14 Aug. Washinton

Smith, R.H., Palmer, R., Reade, A.E. (1975). J. Sci. Fd Agric. 26, 785-795

Topçuoğlu, S. (1973). Presented at the 4th Turkish Sci. Cong. 5-8 Nov. Ankara

Turner, M.F. (1979). J. mar. biol. Ass. U.K. 59, 535-552

Ukeles, R. (1962). Appl. Microbiol. 6, 532-537