| Cercetări marine | I.R.C.M. | Nr.16 | 255 - 262 | 1983 |
|---|---|---|---|---|

# THE EFFECT OF ES--SIDER CRUDE OIL ON THE METABOLISM OF MARINE UNICELLULAR ALGAE

*Pia – Elena Mihnea*

Romanian Marine Research Institute - Constanța

ABSTRACT:

Results on the water extractable crude oil on four unicellular marine algae are presented. Different temperature ranges (8 - 12; 21 - 23 and 24 - 26°C) have induced different algal behaviour in the presence of crude ES SIDER oil compounds. The possible metabolic mechanism of algae exposed to crude oil is suggested.

## INTRODUCTION

The literature regarding the effects of oil on phytoplankton, underlines that natural communities are adversely affected by oil. Laboratory experiments performed on some microscopic algae are dealing with effect of water extractable substances from crude oil.

Besides different water extractable compounds are: naphtalene, kerosene, phenol, etc. The effect of this compounds depends on concentration, time of contact with algae, specific algal sensitivity as well as on the sort of experimented oil.

LACAZE (3) reported a depression in the growth rate of Phaeodactylum tricornutum BOHL. exposed to one percent extracts of Kuwait crude.The uptake of labelled bicarbonate by Monochrysis

lutheri DROOP (= Pavlova lutheri (DROOP) GREEN) was significantly reduced by crude oil emulsion at concentration of 50 ppm (1).

Testing on some unicellular algae a 0.01 ml $l^{-1}$ oil concentration for a short while, no effect was observed (7).

In chronic effects experimentation a depression of number of generation was obtained (8). MIRONOV and LANSKAIA (9) found that the diatoms Ditylum brightwelli (WEST) GRUN., Coscinodiscus granii GOUGH., and Chaetoceros curvisetus CL. were killed within 24 hours by 100 $\mu$g/l or less of kerosene and fuel oil, although Melosira moniliformis (O. MÜLL.) AG. and Grammatophora marina (LYNGB.) KTZ. tolerated concentrations up to one percent.

GORDON and PROUSE (2) studied the effect of some different sorts of oil and found different effects on algae.

Taking into account the diversity of unicellular algae answers to water extractable crude oil products, an experiment with ES SIDER sorte was performed.

MATERIALS AND METHODS

Skeletonema costatum (CL) GREV., Cyclotella caspia GRUN, Chaetoceros simplex v.calcitrans PAULS and Chlamydomonas sp. were used as they represented large spreaded species. All of them were in exponential phase when the experiment had started.

ES SIDER (Libya) crude oil was dialysed (VISKING TUBING C-97 membrane) in sea water at a 1 to 1000 ratio. The dialysis was done in three temperature ranges (8-12; 21-23 and 24-26°C) similar to those used throughout the experiment for each alga species. The dialysis time was: 48 hours for 8-12°C temperature range, and 24 hours for 21-23 and 24-26°C. Different time for dialysis was chosen according to the general correlation between the temperature and solubility.

The sea water was brought from offshore (10 Nm), stored into Laboratory for two weeks, filtred on Millipore HA membrane, and enriched with nutrients (MS medium (5)). A control lacked by oil soluble products for each alga and each temperature, was considered.

The culture system was run on a 16:8 L:D cycle, in 2,500 lx light intensity, and continuous air bubbling.

The effect of sea water extractable compounds were measured as culture density (cell no x $ml^{-1}$) using a Fuchs-Rhosental chamber.

## RESULTS AND DISCUSSION

For all studied variants a high specific behaviour was observed concerning both protection and recovering capacity.

### 1. The adaptative capacity

MIHNEA and cowork.,(6) have demonstrated that unicellular algae possessed physiological abilities that acted into membrane transport.

The adaptative capacity into a system polluted by toxic ions depends on algal peculiarity to accumulate some other ions identical as molecular weight and electrical charge. The elimination of toxic compounds is due to the selective absorbtion of the mentioned ions. Although the results of the present study are not refering to the intimate mechanism,it seems that the presence of soluble products of ES SIDER crude oil had triggered a similar algal behaviour.

The retarded rate of cell division or a depression in the growth of cultures reflect the intoxication - desintoxication process induced by selective absorbtion and toxic compound excretion. Desintoxication can be due to a protein susceptible to bind toxic ions, too (4).

Under the experiment circumstances these events take place on the 24-48 up to 72 hours.

### 2. The recovering capacity

When the equilibrium between toxic ions and antitoxic process can be stated, the cell recovering is possible. The recovered culture must have a cell division rate close or identical to that happened into control, or at least, to show a trend of cellular division regaining.

Throughout the experiments the following cell division features were observed:

- it was highly depressed up to zero and than, cellular

destruction was obviously;

- not affected; cell density close or identical to the control;

- it was stimulated; cell density being over the control.

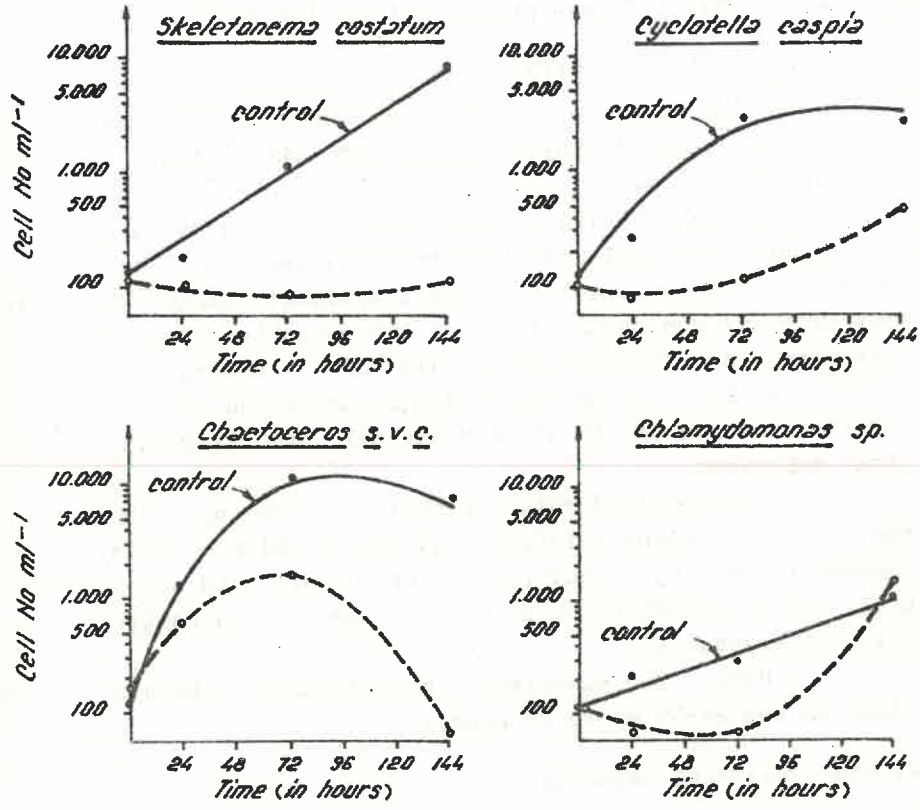


Fig.1 - The growth of algae at 8-12°C in the presence of water extracted products from ES SIDER crude oil

On the first 24 hours at 8-12°C Skeletonema, Cyclotella and Chlamydomonas stoped the cell division or showed a significant depression in the growth rate (Fig. 1). It could be supposed that the protection mechanism against the toxic ions penetration are disturbed. That capacity on the first 72 hours of experimentation was present only to Chaetoceros (Fig.1). Metabolic recovering only

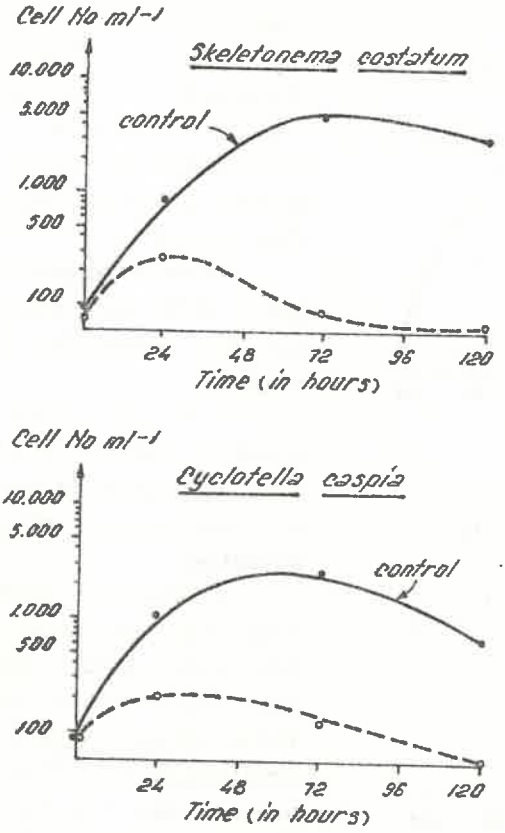


Fig.2 - The growth of algae at 21-23°C in the presence of water extracted products from ES SIDER crude oil

in Cyclotella and Chlamydomonas have certainly occured, Chaetoceros was lacked by that function.

It is known that the increase of temperature produce an increased algal metabolism. Within 21-23°C the increase of metabolic reactions induced a low capacity of algal protection, as well as the loss of metabolic recovering possibilities (Fig. 2,3). The exception was done by Chlamydomonas; on the first 24 hours a complete metabolism recovering was observed. Thereafter, on the 96 hours of water extractable oil compounds contact with algal cells, a stimulatory effect had taken place.

Temperature ranging between 24 and 26°C have modified much deeper the algal protection capacity (Fig. 4). The protection mechanism acts very short, than cultures collapsed. Chlamydomonas was an exception; it has shown metabolic recovering abilities although cell densities remained under the control.

CONCLUSIONS

- Experiments on ES-SIDER contact with unicellular algae in different temperature ranges (as this factor could be in different seasons or latitudes) are carried out for the very first

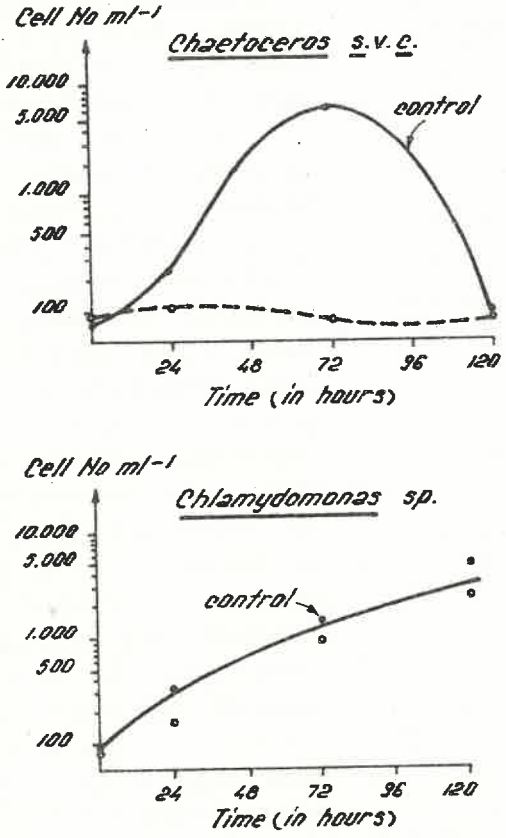


Fig.3 - The growth of algae at 21-23°C in the presence of water extracted products from ES SIDER crude oil

time;

- The results were discussed on some algal metabolic features previously observed by author in the presence of some other pollutants;

- Culture growth suggests both the protection and the recovering capacity;

- On the first 24 hours of experimentation, most of algae have shown a depression of cell division;

- Cellular distruction was possible only for some algae and for some temperature conditions (Chaetoceros 8-12°C; Cyclotella 24-26°C); this process has occured after 72 hours of experimentation;

- The protection algal capacity against the ES-SIDER water soluble products has a high specificity and acts on first 24-48 hours up to 72 hours of contact;

- The metabolic recovering acts after 72 hours of contact;

- Water extractable ES-SIDER products have shown a stimulatory effect exclusive to Chlamydomonas.

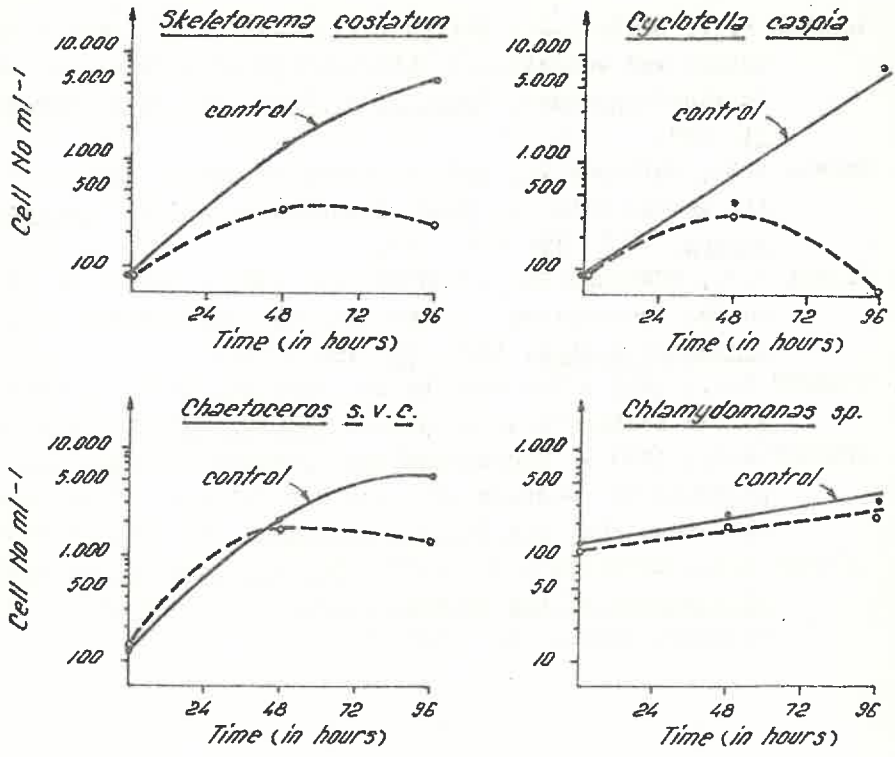


Fig.4 - The growth of algae at 24-26°C in the presence of water extracted products from Es SIDER crude oil

REFERENCES:

1. ANONYMOUS, 1977 - Aspects of Marine Pollution (GESAMP), Impact of oil on the marine environment. Rep.Stud.GESAMP, IMCO/FAO/UNESCO/WMO/WHO/IAEA/UN Joint Group of Exp. on Sci., 6: 1 - 250.

2. GORDON D.C.Jr., PROUSE N.J., 1973 - The effects of three oils on marine phytoplankton photosynthesis. Mar. Biol. 22: 329 - 333.

3. LACAZE J.C., 1967 - Etude de la croissance d'une algue planctonique en présence d'un détergent utilisé pour la destruction des nappes de pétrole en mer. C.R.Hebd.Séances, Acad.Sci.Paris (D): 489.

4. MacLEAN F.I., LUCIS O.J., SHAIKH Z.A., JANSZ E.R., 1972 - The uptake and subcellular distribution of cadmium and zinc in microorganisms. Fedn. Proc. Fedn. Am. Socs. exp.Biol. 31: 699.

5. MIHNEA P.E., VOINESCU I., 1977 - Effect of phenol and β-indolil acetic acid on some unicellular algae. Cercetări marine, IRCM, 10: 225 - 242.

6. MIHNEA P.E., MUNTEANU Gh., PECHEANU I., 1981 - Effect of $Cd^{2+}$ on the metabolism of the marine unicellular algae. Cercetări marine, IRCM, 13: 199 - 211.

7. MIRONOV O.G., 1961 - The results of sanitary investigation of marine sediments along shores. Zdravookhr.Beloruss.,5.

8. MIRONOV O.G., 1970 - Microorganisms growing on oil and oil products in western and central regions of the Mediterranean Sea. Rev.Int.Oceanogr.Méd., CERBOM, 17:79-85.

9. MIRONOV O.G., LANSKAYA L.A., 1967 - Biology and distribution of plankton of the southern seas. Oceanographical Commission, Moskow (in russian).