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THE USE OF ^{14}C METHOD BY LIQUID SCINTILLATION COUNTING FOR ESTIMATING PLANKTONIC PRIMARY PRODUCTIVITY OFF THE ROMANIAN BLACK SEA COAST[1)]

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ABSTRACT:

Preliminary results obtained by ^{14}C method, using liquid scintillation counting, on planktonic primary productivity off the Romanian Black Sea coast during July, 1977 (238-825 mg C $m^{-3}day^{-1}$) are presented.

The methodology of planktonic primary productivity estimation affords a fairly large number of working techniques (7). Direct and indirect methods have different values; the ^{14}C method is the most frequently used all over the world.

The ^{14}C method has not been applied so far in the Romanian oceanological research, some aspects and implications only of this technique having been thrown into relief (1); the utility of the planktonic primary productivity data as obtained by the ^{14}C method lies in their correlativity with those on biomass and distribution of the succesive animal consumers, in order to

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estimate the bioproductivity of an aquatorium on the whole, particularly the fish productivity.

The applicability of the ^{14}C method by liquid scintillation counting was tested in 1977 - as a methodological development on the Romanian coast - with the purpose of establishing the possibilities of planktonic primary productivity estimation in an aquatorium with particular ecological conditions.

MATERIAL AND METHOD

Phytoplankton samples were collected within the sea water stretch of Constanţa-Agigea in July, in a 1 n.m. long section perpendicular to the shore, at three stations, from the following horizons: Station 1-0 m, Station 2-0 m, Station 3 - 0 m, Station 3 - 0, 5 and 10 m (6 horizons, in all).

The ^{14}C method was used (1o), within the instructions of the International Agency for ^{14}C Determination (8), by liquid scintillation counting (5).

According to the in situ "simulated" experimental variant, the 25o ml light and dark bottles containing phytoplankton from the six horizons were each added 1 ml $NaH^{14}CO_3$ solution and maintained in a water basin, exposed to natural illumination. Each sample was tested with 5, 1o and 25 μCi activities in order to select, for our purposes, the optimum activity. The upper (0 m) and deep (5 and 1o m) samples were kept at the same level in the basin, at integral illumination (100%), under temperature control; photosynthetic assimilation experiments were performed p.m., within the period between culmination and sunset.

Just at the end of the exposing period, the contents of the bottles were filtered, for measuring the radioactivity of the phytoplankton residuum.

As known, in this type of measurements, the use of the liquid scintillation counting, compared to Geiger-Müller procedure (2), has advantages, e.g. by the elimination of self-absorbtion errors due to the radioactive material on the filters (which is possible in the case - frequently encountered along the Romanian coast - of a rich suspension content of the sea water).

The filters with the radioactive algal residuum were

measured in Packard polyethylene vials with low background; the selected scintillation mixture composed of 2 ml dioxan(previously introduced for filter solubilization)and 8 ml liquid scintillator (prepared from o.5 g POPOP s.g.[1], 5 g p-terphenyl s.g. and 1,ooo ml toluene s.g.) was added into each vial.

At the same time, in order to check the efficiency and the grade of this scintillation mixture, two other receipts were also tested: 2 ml dioxan and 8 ml Instagel[2] and respectively 2 ml dioxan, 8 ml Instagel and 0.1 ml hyamine-hydrate; no improvement of the efficiency of the liquid scintillator, was observed.

The radioactivity measurements were carried out after 24 hours at +5°C with a Packard Tri-Carb model 3385 automatic scintillation spectrometer and with a Nuclear Enterprises LSC1 type manual scintillation spectrometer; all the obtained results, similar for both kinds of tools, are reliable.

Each sample was measured three to five times (1 min. per sample with the automatic spectrometer and 4-5 min.per sample with the manual one).

RESULTS AND DISCUSSION

Calculation of primary productivity values in the stretch of Constanţa-Agigea on the basis of the ^{14}C measurements was carried out by the formula (4):

$$C_p = \frac{C_c \cdot r}{R}$$

where: C_p = photosynthetic assimilation value of the sample during the exposure period (mg C l^{-1});

C_c = total inorganic carbon content of the water (CO_2, HCO_3^-, CO_3^{2-}) (mg C l^{-1});

r = radioactivity of ^{14}C assimilated by phytoplankton (filter radioactivity)

R = radioactivity of inoculated ^{14}C solution.

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1) scintillation grade

2) Instagel (Packard), universal liquid scintillator, patented, ready prepared, a cocktail specially used for aqueous samples (Packard Catalogue No.6oo2173).

The mean value of the total inorganic carbon content of the oceanic water - 25 mg C l^{-1} - was assumed for C (cf. 9); as the experiment duration was 1/2 of a solar day, the diurnal primary productivity rate was calculated by multiplying the results by 2.

A particular aspect of the calculation is given by the determination of the control - that is the correction for CO_2 fixation in darkness (about 1-3%) with the dark bottles. Usually, on the analogy of the method of the O_2 bottles, the values obtained with dark bottles are scribed to respiration, permitting a distinction between gross and net productivity (by substraction). On the basis of the specification of the modalities and significance of the ^{14}C fixation in darkness (3, 6, 9), it is recommended that the values obtained in the dark bottles should be neither subtracted from those of the phosynthetic assimilation, nor calculated as percents of them, but expressed separately, as absolute values, beside the value obtained in the corresponding light bottle (or bottles) at the same time.

The main purpose of the present research is the outlining of the possibility of application of the ^{14}C method in estimating the planktonic primary productivity along the Romanian coast; the properly results of primary productivity are tentative; they are expressed in mg C m^{-3} day^{-1}.

The results obtained in the offshore zone of Constanţa-Agigea in the summer denote planktonic primary productivity values ranging between 297-825 mg C $m^{-3}d^{-1}$ in the upper water layer, and between 238-243 mg C $m^{-3}d^{-1}$ at the depths of 5 and 10 m.

As it has been specified above, the values obtained by fixation in darkness were not subtracted from those of the photosynthetic assimilation, but considered apart, beside the average of the values obtained in the corresponding light bottles.

The examination of the results pointed out the necessity of taking into consideration the measurement values of the third experimental activity used (25 μCi $NaH^{14}CO_3$).

CONCLUSIONS

1. For the first time the ^{14}C method for estimating the planktonic primary productivity was used in the ecological condi-

tions of the Romanian coastal waters.

2. The best liquid scintillation used was the mixture: dioxan, POPOP and p-terphenyl in toluene.

3. The planktonic primary productivity data in the offshore zone of Constanţa-Agigea (Black Sea), obtained by the ^{14}C method, ranged between 238-825 mg C $m^{-3}day^{-1}$.

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