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Determination of the Absorption of Cr^{+6} and Cr^{+3} in an Algal Culture of *Chlorella pyrenoidosa* Using ^{51}Cr

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INTRODUCTION

Experiments on the radioactive isotope Cr-51 have shown an effect of accumulation of 90% or more after 3 days, when Cr-51 as Cr^{+3} was added to a culture of the beach diatom Chaetocerus armatum (NELSON and EVANS 1969). As for the Cr^{+6}, field observations show that this ion will remain stable throughout a period in water rich in oxygen (SHEPHERD and JONES 1971). The purpose of this experiment was to determine if Cr^{+6} and Cr^{+3} would be equally absorbed in a green algae culture of Chlorella pyrenoidosa when Cr-51 is tracer.

MATERIALS AND METHODS

To each of four bottles is added about ½ mci as Cr^{+6} or Cr^{+3} (see Table 1) and in two of the four bottles the algae concentration is 1 x 10^8 algae/liter. The algae nutrient liquid is a modified Østerlinds medium (WIUM-ANDERSEN 1974) and two of the bottles contain nutritive liquid and act as a control. The temperature is 23 °C and pH is 6.8. Each bottle contains 75 ml liquid and stirring is done by a magnet. The bottles are exposed by a Philips 33 TL/20 W fluorescent tube. As the isotope used has a low specific activity - 2.31 ci/g - the bottles contain an amount of chromium, viz 4ppm Cr^{+6} and Cr^{+3} respectively. Samples are taken after 3 hours for the first time; 15 ml is taken which is filtered with Sartorius membrane (diaphragm) filters - the size of pore is 0.6 - 0.8 u. Filters and filtrate are

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determined by a solid state scintillation counter 4 times 10 seconds each. In this case, the decay of Cr-51 has been left out of account, being less than 5%.

RESULTS AND DISCUSSION

After the first three hours the concentration of algae will be almost the same in the bottles of algae (bottle 2 and 4 in Table 1), and compared with the control experiment, it is shown, that already after three hours the algae have absorbed a distinct amount of Cr^{+3}. This is not the case in the bottles of Cr^{+6}. After 22 hours the algae concentration in bottle 2 is found to be 2×10^8 algae/liter while in bottle 4 it is 8×10^8 algae/liter. Under similar conditions without addition of chromium the expectable growth after 22 hours would be 9×10^8 algae/liter. Under the present conditions Cr^{+6} has had an inhibiting effect on the growth of Chlorella, while Cr^{+3} has not. Therefore, experiments 2 and 4 cannot be compared directly as the algae concentration is stagnating in bottle 2 but exponentially growing in bottle 4. It is seen from bottle 2 that during the first 21 hours there is negligible absorption of Cr^{+6} by the algae. From the experiment of Cr^{+3} it is seen that the time factor and the increased growth of algae will cause an increasing activity of the filter compared with the control experiment, which is in accordance with SHEPHERD and JONES (1971).
It is conceivable that the filter itself will retain activity and there may be smaller particles in the nutrient liquid. The relatively lower activity on the filters, when control experiment 1 is compared with the control experiment 3, must be due to the larger affinity of Cr^{+3} to surfaces. The total activity in bottle 3, i.e. filter and filtrate together, is already low after three hours and is declining further throughout the experiment.

TABLE 1

Cr^{+3} and Cr^{+6} absorption in a Chlorella pyrenoidosa culture.

Bottle		After 3 hours		After 21 hours		After 32 hours	
		counts pr min	% of total counts	counts pr min	% of total counts	counts pr min	% of total counts
1 Cr^{+6}	Filter	57000	16	49000	15	36000	11
	Filtrate	295000		285000		287000	
2 Cr^{+6}	Filter+algae	55000	17	45000	14	25000	9
	Filtrate	273000		271000		263000	
3 Cr^{+3}	Filter	90000	37	60000	47	37000	42
	Filtrate	151000		68000		50000	
4 Cr^{+3}	Filter+algae	148000	43	266000	84	274000	91
	Filtrate	193000		50000		28000	

This effect may be due to the fact that Cr^{+3} is stuck to the surface of the glass and the magnetic stirrer for want of other surfaces.
Cr^{+3} will be stuck to surfaces in water such as algae to a larger extent than is the case for Cr^{+6}, and Cr^{+3} will be removed from the water itself.
There are reasons to expect that this proces will be rather fast.

REFERENCES

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