PRELIMINARY RESULTS ON CHITIN BIOMASS IN SOME BENTHIC MARINE BIOCENOSES

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ABSTRACT

In an attempt to compare chitin productivity in different biocenoses from an ecological point of view, chitin biomass of some benthic communities was measured on Corsica northwest coasts (Calvi, Mediterranean Sea).

In the infralittoral communities of photophilous algae characterized by *Cystoseira stricta* or *C. crinita*, the chitin biomass (excluding Decapod Crustaceans) was found relatively constant and amounted from 300 to 1100 mg chitin. m^{-2} (average 717 mg chitine. m^{-2} ± 280) mainly due to exoskeletons of epiphytic encrusting organisms, such as bryozoans. Chitin biomass of Decapod Crustaceans was far more variable.

Sciaphilous communities of semi-darked caves, dominated by sponges, had a lower chitin biomass, amounted from 130 to 370 mg chitin.m^{-2} (average 268 mg.m^{-2} ± 106).

Depth, from 5 to 35 meters, and slope did not seem to affect chitin biomass values.

INTRODUCTION

The recent technological applications of chitin and chitosan led to the search of alternative sources of chitin, either by rearing chitin-producing organisms or by exploiting the natural environment (1,2, 3). As a matter of fact, the potential sources are essentially based on the exploitationof cuticular chitin synthesized by Arthropods (Insects or Crustaceans) or of mycelial chitin of molds and fungi.

It is well known, however, that chitin biosynthesis is a widely distributed property in the animal kingdom (as far as Invertebrates are concerned)(4,5). Chitin is indeed a very important constituent of the organic matter of different kinds of exoskeletal or cuticular structures, such as Ciliate cysts, Coelenterate perisarc, Nematode and Rotifer egg envelopes, Bryozoan ectocysts, Inarticulate Brachiopod shells, Annelid setae, Mollusk shells, and so one. The possible use of these exoskeletal structures as a source of chitin on an industrial scale depends upon their production rate and their accumulation in natural environments. The knowledge of chitin production and biomass in different ecosystems, as well as the rate and mecanisms of biodegradation processes, are also important aspects of Carbon and Nitrogen biogeochemical cycles.

Despite their fundamental interest in basic ecology, there are very few if any quantitative data on chitin biomass in natural environment. The present paper deals with some results on chitin biomass identified in two types of marine benthic biocenoses, which are widely distributed on rocky coasts of the infralittoral fringe in Mediterranean Sea. This is a preliminary report on a more extensive program on chitin production, biomass and biodegradation in marine environment.

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EXPERIMENTAL

The analytical work was performed on samples gathered in June 1979 and June 1980, on rocky coasts of northwest Corsica (a french island in Mediterranean Sea) in the vicinity of the Oceanographic Station of Liège University "STARESO" near Calvi.

Two dominant types of biocenoses were especially investigated; they were delimited, characterized and defined according to Pérès and Picard (6). The first one is an infralittoral community of photophilous algae, characterized by the brown-algae species *Cystoseira stricta* and *Cystoseira crinita*, growing on rocks in well enlighted conditions. The second one is a sciaphilous community growing in semi-darked caves. Samples of each of these biocenoses were gathered at different depths, from 0 to 35 meters, on rocks with different slopes.

Samples were collected during scuba-diving. Each sample was made up of the whole biological cover of a given rocky surface, generally 0.040 m^2 (in some cases : 0.25 m^2). The surface was delimited by a metallic frame, firmly pressed on the rock. "Vagile" fauna, i.e. benthic animals able to escape more or less quickly during manipulations, was sucked with the aim of an air lift sucking pipe sampler (7) and collected in a narrow-mesh nylon bag. Thereafter, the whole biological cover fixed to the substrate was scraped, the detached material being collected by continuous sucking into a second nylon bag, until complete peeling of the sampled surface. Bags were brought without delay to the oceanographic station.

Some samples were sorted in order to state the participation of each zoological group to chitin biomass.

Most samples were handled as follows, with a view to chemical analysis. Crustaceans of appreciable size (taller than 5 mm long) were sorted in order to be analysed separately. The rest of the scraped material,and the sucked one, were washed with distilled water, dried at 70°C until reaching constant weight than ground in a "Ika-werk" grinder. The homogeneous dried powder was used for $CaCO_3$ and chitin determinations.

The dry powdered material was subjected to decalcification in HCl 0.5 N at room temperature and to treatment in NaOH 0.5 N at 100°C during 3 hrs in order to set chitin free from glycoproteic complexes and allow further complete enzymatic hydrolysis. Chitin was measured by enzymatic method (4,8) using purified chitinase preparations (Koch-Light, or laboratory preparations from *Streptomyces antibioticus* cultures). Incubations in chitinase solutions at pH 5.2 and 37°C were repeated until chitin hydrolysis was achieved. The hydrolytic products were than incubated in N-acetyl-glucosaminidase solution (from lobster serum) and N-acetylglucosamine was measured by colorimetry (9).

RESULTS

Preliminary investigations were performed in order to estimate the contribution of each taxonomic group of living beings to chitin biomass, in the infralittoral community of photophilous algae characterized by *Cystoseira stricta* and *C. crinita*. Algae amounted up to 90 % of the total organic biomass. Their contribution to chitin biomass was relatively high, certainly due to encrusting animal organisms remaining on fronds. Sponges often represented more than half of the total animal biomass, but contributed only to 10 to 20 % of the chitin biomass, due to epibiotic and endobiotic chitinous organisms, mainly small Crustaceans, living in or on sponges. Bryozoans generally represented 10 % of the total animal biomass, but their contribution to chitin biomass was relatively constant (5 to 10 %). When compared to other organisms, Decapod Crustaceans of appreciable size exhibited the widest variations, contributing often for more than half of the total chitin, but being sometimes lacking in the sample. This latter observation led us to sort

Decapod Crustaceans taller than 5 mm, from every sample, and to analyse separately their specific contribution to the chitin biomass of the sample.

Table I shows, in the case of 14 samples of the infrallitoral community of photophilous algae, the chitin biomass contribution of benthic organisms gathered by scraping, of material gathered by sucking before sampling the biological cover, and of Decapod Crustaceans taller than 5 mm long. The samples are grouped according to depth. The amount of total material gathered is expressed in dry weight per square meter.

Table I : Total chitin biomass in infralittoral communities of photophilous algae (characterized by *Cystoseira crinita* and *C. stricta*) on rocky coasts of northwest Corsica, and specific contribution of Decapod Crustaceans (1) to chitin biomass.

Sample n°	Depth	Total dry weight $g.m^{-2}$	Chitin biomass, $mg.m^{-2}$				
			Benthic (Crustaceans excluded) (1)			Decapod Crustaceans (1)	Total
			scraped	sucked	total		
6	- 5 m	1 524	523	63	586	188	775
17	- 5 m	1 942	369	17	386	56	442
1	- 7 m	2 567	776	97	873	1 807	2 681
3	- 9 m	2 889	973	104	1 078	1 016	2 094
5	- 9 m	3 921	644	276	921	57	978
8	- 10 m	1 756	498	48	546	375	1 011
16	- 11 m	1 578	...	..	1 117	372	1 489
2	- 13 m	1 261	344	51	395	135	530
4	- 17 m	1 877	785	69	854	106	1 760
11	- 19 m	1 906	268	89	357	328	685
12	- 19 m	1 193	259	57	316	101	417
13	- 19 m	1 545	715	173	888	0	888
7	- 20 m	3 513	696	276	972	50	1 022
9	- 30 m	2 726	480	270	750	0	750
average :		2 168.20	563.84	122.30	717.07	385.07	1 108.71
standard deviation s =		808.16	221.33	93.99	280.17	519.00	666.33

(1) Decapod Crustaceans taller than 5 mm (long).

Table II gives the chitin biomass obtained from 6 samples of sciaphilous community growing in semi-darked caves, at different depths. These samples contained very few algae; sucked and scraped material were got together owing to the little amount of material gathered by sucking.

Table II : Total chitin biomass in sciaphilous communities growing in semi-darked caves, on rocky coasts of northwest Corsica, and specific contribution of Decapod Crustaceans(1) to chitin biomass

Sample n°	Depth	Total dry weight $g.m^{-2}$	Chitin biomass, $mg.m^{-2}$		
			Benthic (Crustaceans excluded) (1) (Scraped + sucked)	Decapod Crustaceans (1)	Total
19	- 10 m	-	136	30	166
15	- 11 m	1 769	347	7 100	7 447
18	- 17 m	320	143	0	143
20	- 17 m	998	267	0	267
14	- 20 m	372	373	0	373
10	- 28 m	888	347	0	347
average :		869.4	268.83	-	-
standard deviation s =		586.4	106.35		

(1) Decapod Crustaceans taller than 5 mm (long).

DISCUSSION

The analytical data shown in Table I and II are the first quantitative informations available concerning the relative importance of chitin in natural biocenoses of marine environment.

The material collected by sucking before sampling the biological cover was often low but sometimes relatively important. Its contribution to total chitin biomass of benthic material (Decapod Crustaceans excluded) amounted up to 33 % in one case. It thus appear that this precautionary measure was useful for a correct sampling.

In both benthic communities so far analysed, the total chitin biomass (excluding that of Decapod Crustaceans) was relatively constant. Chitin biomass was generally low and amounted about 720 $mg.m^{-2} \pm 280$ (average value) in the infralittoral communities of photophilous algae. The chitin biomass value estimated in sciaphilous communities of semi-darked caves was only 268 $mg. m^{-2} \pm 106$ (average value). This appears as a consequence of the reduction of algae vegetation, and of its epiphytic covering.

The depth of the sampling, between 0 and 35 meters, as well as the slope of the rocky surface sampled, do not seem to modify significantly the value of chitin biomass.

The contribution of Decapod Crustaceans (taller than 5 mm long) to chitin biomass of a given community seems to be more variable, probably due to the size of the samples. The chitin biomass of the Decapod Crustaceans is sometimes higher than that of all other chitinous organisms in a given sample. On basis of the average values, however, the chitin of these Crustaceans represents 34.7 % of the total chitin biomass, in the infralittoral community of photophilous algae at least.

Despite their relatively very low organic biomass, Decapod Crustaceans thus appear as being the dominant animal group in chitin bioproduction, as far as these infralittoral marine communities are concerned. Beside Crustaceans, the biological communities of these mediterranean infralittoral rocky coasts will hardly offer a valuable alternative source for chitin exploitation.

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REFERENCES

1. Murray, A.E. and Hattis, D., Proceedings First internat. Conference Chitin/Chitosan, Muzzarelli and Pariser ed., M.I.T. Cambridge, Mass., (1978), 30-44.
2. Anderson, C.G., De Pablo, N. and Romo, C.R., Proceedings First internat. Conference Chitin/Chitosan, Muzzarelli and Pariser ed., M.I.T. Cambridge, Mass (1978), 54-63.
3. Allan, G.G., Fox, J.R. and Kong, N., Proceedings First internat. Conference Chitin/ Chitosan, Muzzarelli and Pariser ed., M.I.T. Cambridge, Mass (1978), 64-78.
4. Jeuniaux, Ch. Chitine et chitinolyse, un chapitre de la biologie moléculaire. Masson ed., Paris (1963), 181 pp
5. Jeuniaux, Ch., Bull. Soc. Zool. France, 107, (1982), in the press.
6. Pérès, J.M. et Picard, J., Recueil Travaux Stat. Marine Endoume, 31 (1964) 1-137.
7. Bussers, J.C., Poulicek, M. and Diepvints, J., Cah. Biol. Marine, 23 (1982) in the press.
8. Jeuniaux, Ch., Bull. Soc. Chim. Biol., 47 (1965) 2267-2278.
9. Reissig, J.L., Strominger, J.L. and Leloir, L.F., Jour. Biol. Chem., 217 (1955), 959-966.