

Major Biochemical Constituents of Some Faunal Components of the Cochin Backwaters

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Major biochemical constituents in some of the dominant estuarine forms such as *Corophium triaconyx*, *Diopatra naeopolitana*, *Cirolana fluviatilis*, *Meritrix casta*, *Alpheus rapax*, *Acetes cochiniensis* and *Acartia* sp. from Cochin backwaters were estimated and the calorific values calculated. The animals showed highest concentrations in various biochemical constituents during the period of their maximum occurrence in the environment. The isopod *Cirolana fluviatilis* had highest lipid content (64.8%) and total calorific value (6764 cal/g).

NEED for biochemical investigations in the study of metabolic pathways and trophic relationships in aquatic communities is well recognized. Many workers have stressed the value of detailed biochemical investigations in estimating the energy content and production potential of marine and estuarine systems¹⁻⁸. Although considerable amount of information is available on these aspects for temperate and cold water animals, very little is known for tropical communities. The present paper describes biochemical composition of some of the dominant species (mostly benthic) of the Cochin backwaters, which play an important role in the food chain of the ecosystem. Those studied, belong to the groups Amphipoda, Polychaeta, Isopoda, Bivalvia, Decapoda and Copepoda. Owing to varying hydrographic conditions of the environment there is a distinct seasonal fluctuation of the groups and the estimations are therefore restricted to the months during which the specific groups are available in sufficient quantities.

The Environment

The Cochin backwaters are subjected to wide fluctuations in hydrographical conditions particularly salinity. During the south-west monsoon period (June-September) the system is fresh water dominated and the salinity values are as low as 1‰ at the surface and at the bottom the values are lower than 10‰. The fresh water flow is maximum during this period. Evaporation and the reduced fresh water flow during the premonsoon period result in an increased salinity (> 30‰)^{9,10}. Madhupratap *et al.*¹¹ have reported in Cochin Backwaters the sequences of fluctuations in the abundance and ecological succession of the fauna in relation to the changes in salinity.

Materials and Methods

Zooplankton samples were collected using an HT net and the benthos by Vanveen grab. The animals were brought alive to the laboratory and the following biochemical constituents viz. carbohydrate, protein and lipid as well as water, ash and

chitin were estimated in the fresh sample. Protein was estimated by the biuret method, total lipid by the gravimetric estimation of Folch *et al.*¹² and carbohydrate according to the method of Dubois *et al.*¹³ with modifications as described by Raymond *et al.*¹⁴. Simultaneous wet and dry weight measurements were made using another set of animals. Wet weight of the undamaged organisms were taken after removing the surface water with a blotting paper. Dry weight was taken after keeping them in an oven at 60°C until constant weight was obtained. Calculated values for carbohydrate, protein and lipid are expressed as percentage of wet and dry weights. Total calorific values were calculated using the calorific equivalents 5.7 for protein, 9.45 for lipid and 4.2 for carbohydrate⁷.

Results and Discussion

Various biochemical constituents estimated in different animals are given in Table 1. The values are the averages of a few estimations and expressed as percentage of unit weight. The total of the different biochemical fractions in the present measurements have been more than 90% of the dry weight. Considering the fact that non-protein nitrogen has not been estimated the recovery rate may be considered to be satisfactory. This agrees well with that of Corner *et al.*¹⁵, who have suggested a value of non-protein nitrogen as approximately 10% for crustacean zooplankton.

Water content — The percentage of dry to wet weight in various animals varied from 16.6 to 41.5%. Highest water content was observed in *Acartia* sp. (83.4%). The water content in copepods and *Acetes* in the present estimations was lower than that reported by Nair *et al.*¹⁶. Some zooplankton animals absorb water during periods of low nutrition and this could well account for the differences in these values.

Carbohydrate — Carbohydrate values for zooplanktonic organisms are low (4.1 to 5.3% on dry weight basis). These values are on the higher side than those reported by Raymond *et al.*⁵ for the euphausiid *Meganctiphanes norvegica* (1.1 to 3.7%). Similarly

TABLE I — AVERAGE VALUES FOR MAJOR BIOCHEMICAL CONSTITUENTS

Group	Period of maximum occurrence	Weight, g		Per cent	Water content %	Per cent wet wt			Per cent dry wt				Calorific value		
		Wet	Dry			Carbo-hydrate	Pro-tein	Lipid	Carbo-hydrate	Pro-tein	Lipid	Ash		Chitin	Re-covery %
Amphi-poda	Nov.-Jan.	0.04	0.009	22.5	77.5	2.1	13.4	0.3	9.4	59.5	1.2	9.6	13.1	92.8	3863
Poly-chaeta	Jan., Feb., April, June	0.159	0.066	41.5	58.5	3.5	24.3	5.1	8.5	57.8	12.5	5.3	9.4	93.5	4728
Isopoda	Nov., Dec.	0.046	0.017	36.9	63.1	2.3	2.5	24.0	6.2	6.8	64.8	7.4	8.3	93.5	6764
Bivalve	Dec.-March	0.181	0.061	33.7	66.3	3.3	18.5	4.8	9.5	53.7	14.1	13.8	—	91.1	4755
Alpheid	Jan., Feb.	0.143	0.057	39.8	60.2	2.3	18.6	2.8	5.8	47	7.1	11.1	20.9	91.9	3559
Acetes	April, May	0.046	0.013	28.2	71.8	1.5	14.5	7.9	5.3	51.2	27.9	7.4	2.8	94.6	5740
Acartia	Jan., April, June	0.276	0.046	16.6	83.4	0.7	8.6	4.1	4.1	51.5	25.3	9.9	2.7	93.5	5464

Raymont and Krishnaswamy¹⁷ and Raymont and Conover¹⁸ have reported very low carbohydrate values (not exceeding 1% of dry body weight) for *Calanus* sp. According to these authors such low values could be due to the fact that glycogen, the usual storage carbohydrate in many marine animals, does not form a substantial part of the body reserves. Carbohydrate values were relatively high in benthic animals, bivalves (9.5%), amphipods (9.4%) and polychaetes (8.5%). Carbohydrate values for bivalves are comparable with those values given by Ansell *et al.*⁷ for *Donax* sp.⁷ from this region. Higher values observed may be due to the short term fluctuations of the carbohydrate reserves due to the fluctuations in conditions affecting nutrition of the animal.

Protein — Protein content of isopod was very low (6.8%) while lipid content was very high (64.8%). In all the other groups protein content recorded was high (> 50% of dry weight) and it formed the most substantial part of the body substance.

Lipid — Lipid content in various animals ranged between 12.5 and 64.8%. In amphipods and alpheids the lipid values were very low (1.2 and 7.1% respectively). Highest lipid content was in isopods (64.8%). This seemed to be quite unusual for animals of the tropical region. But all the present values clearly indicated a high percentage of lipid and low percentage of protein in isopods. This could not be attributed to analytical error since the total recovery in all cases was more than 90% of the dry weight. However Fisher¹⁹ reported an average lipid content of 5 to 70% in *Euphausia krohnii* from the North Atlantic. Conover^{20,21} reported lipid values around 60% dry body weight for the cold water copepod *Calanus hyperboreus*.

Calorific content — Calorific value for all the benthic animals were generally in the range of from 3863 to 4755 cal/g dry weight except in isopods which showed an exceptionally high calorific value (6764 cal/g dry weight). In zooplanktonic organisms the calorific content varied between 5464 and 5740

cal/g dry weight. The high calorific value in isopod might be due to the high lipid content. Ansell *et al.*⁷ reported a calorific value for the bivalve *Donax* sp. from this coast, ranging between 4.2 and 4.7 kcal/g dry weight which is comparable with the values reported here for bivalves.

General remarks — Different groups did not occur continuously in sufficient quantities (Table 1) in the Cochin backwaters because of extreme salinity fluctuations brought about by monsoon. Highest values for the different biochemical fractions were observed when these animals were found to occur in large numbers, especially when the system became marine dominated (December-March). This might reflect ideal hydrographic conditions and the general augmentation of the plankton at this time of the year. In polychaetes there was a 2-fold increase in the protein content in April compared to its minimum in February. However carbohydrate and lipid values did not increase during this month and hence maximum values for these were observed in January and February. Isopods had higher lipid values and consequently had the highest total calorific value with no marked monthly variation. Similarly *Alpheus* sp. and *Acetes* sp. did not show monthly variations in the various biochemical components. But in copepods there was a 3-fold increase in protein content in April compared to its minimum observed in January. The difference may probably be due to the difference in the age composition of the material. In copepods the reciprocal relationship between protein and lipid content was evident as reported by Nakai²² and Raymont *et al.*⁴

High lipid values and the absence of a reciprocal relationship with protein in the case of the isopod *Cirolana fluvialilis* and also the bivalve *Meritrix casta* is interesting. In polychaete *Diopatra* sp. lipid content was high in January but decreased drastically as the season progressed and in June it was very low. In *Acartia* sp. lipid content was low in April, but high values were observed for the same in January and June.

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