Mahasagar-Bulletin of the National Institute of Oceanography, 11 (1 & 2), 1978, 105–110.

SEASONAL VARIATION IN MAJOR METABOLITES OF MANGROVE FOLIAGE

A. G. UNTAWALE, N. B. BHOSLE, V. K. DHARGALKAR, S. G. P. MATONDKAR and SAYEEDA S. BUKHARI

National Institute of Oceanography, Dona Paula-403 004, Goa

ABSTRACT

Seasonal variation in carbohydrate, protein, lipid and organic carbon of mangrove foliage belonging to seven species was studied for a period of one year. Among the species investigated, *Derris trifoliata* showed maximum protein concentration, whereas lipid and carbohydrate were maximum in *Acanthus ilicifolius* and *Bruguiera parviflora* respectively. Moisture, ash content and organic carbon did not show significant changes during the period of observation.

Mangroves have evoked a lot of interest recently because they are regarded as important ecosystems in marshy areas (Odum and Heald, 1975). Mangrove trees are also useful for the tannin extraction, paper and pulp industry, wood charcoal etc. (Macnae, 1968). The importance of mangrove swamps has been recently realised because of its detritus content (Odum and Heald, 1975; Odum and de La Cruz, 1967; Fell, Cefalu, Master and Tallman, 1975; Untawale, Bhosle, Dhargalkar, Matondkar and Bukhari, 1976). The mangrove trees by their slow and constant shedding of leaves provide protein rich food material to innumerable marine and estuarine organisms. Various aspects of detritus formation as well as different biochemical changes, during growth and decomposition of fallen leaves, have been studied earlier (Odum and de La Cruz, 1976; Harrison and Mann,1975; Untawale, Bhosle, Dhargalkar, Matondkar and Bukhari, 1976). Golley (1969) is of the opinion that mangrove trees have more energy content than the other tropical rain-forest trees. Recently Bhosle, Dhargalkar, Matondkar and Bukhari (1976) have determined the biochemical composition of mangrove species. In the present investigation, seasonal changes in major metabolites of mangrove foliage were undertaken. The ultimate aim of this type of study is to select, if possible, proper mangrove species for the extraction of leaf protein. Boyd (1971) noted that leaf protein from the unused trees and aquatic weeds could be used as additional source of nutrition.

Actively photosynthesising leaves of *Rhizophora mucronata, Avicennia officinales, Sonneratia acida, Bruguiera parviflora, B. gymnorhiza, Derris trifoliata* and *Acanthus ilicifolius* were collected from the fringing mangroves of Borim and Banastarim (Goa) for the study. The samples were collected every month for the period of one year. The leaf samples collected from seven different mangrove trees were washed with seawater and fresh water to remove adhering material and impurities. Moisture content was determined by drying the freshly weighed leaves at 80°C till a constant weight was obtained. Then they were powdered in a grinder and seived. Seasonal changes in nitrogen, carbohydrate, lipid, organic carbon and ash content were studied following same methodology described earlier (Bhosle, Dhargalkar, Matondkar and Bukhari, 1976).

The variation in the percentages of major metabolites studied have been shown in Figs. 1 and 2. There was a significant variation in the protein (N × 6.25) content in all the species investigated. Maximum values in *B. parviflora* (10.25%) and in *D. trifoliata* (21.71%) were obtained in February and September respectively. Carbohydrate content was found to be 82.76% in *B. parviflora* and 72.1% in *D. trifoliata*. A maximum lipid value (14.71%) was recorded in October in *A. officinalis* whereas minimum value of lipid (6.04%) was obtained in April in *S. acida* (Fig. 1).

Organic carbon varied from 45.74% in January in *D. trifoliata* to 25.14% in September in *A. ilicifolius*. The ash content of *B. gymnorhiza, D. trifoliata, B. parviflora, R. mucronata* and *A. officianalis* did not show much variation during the period of study. However, in *S. acida* and *A. ilicifolius,* monthly fluctuations were recorded ranging from 7 to 12% in *S. acida* and 11 to 17% in *A. ilicifolius* (Fig. 2.)

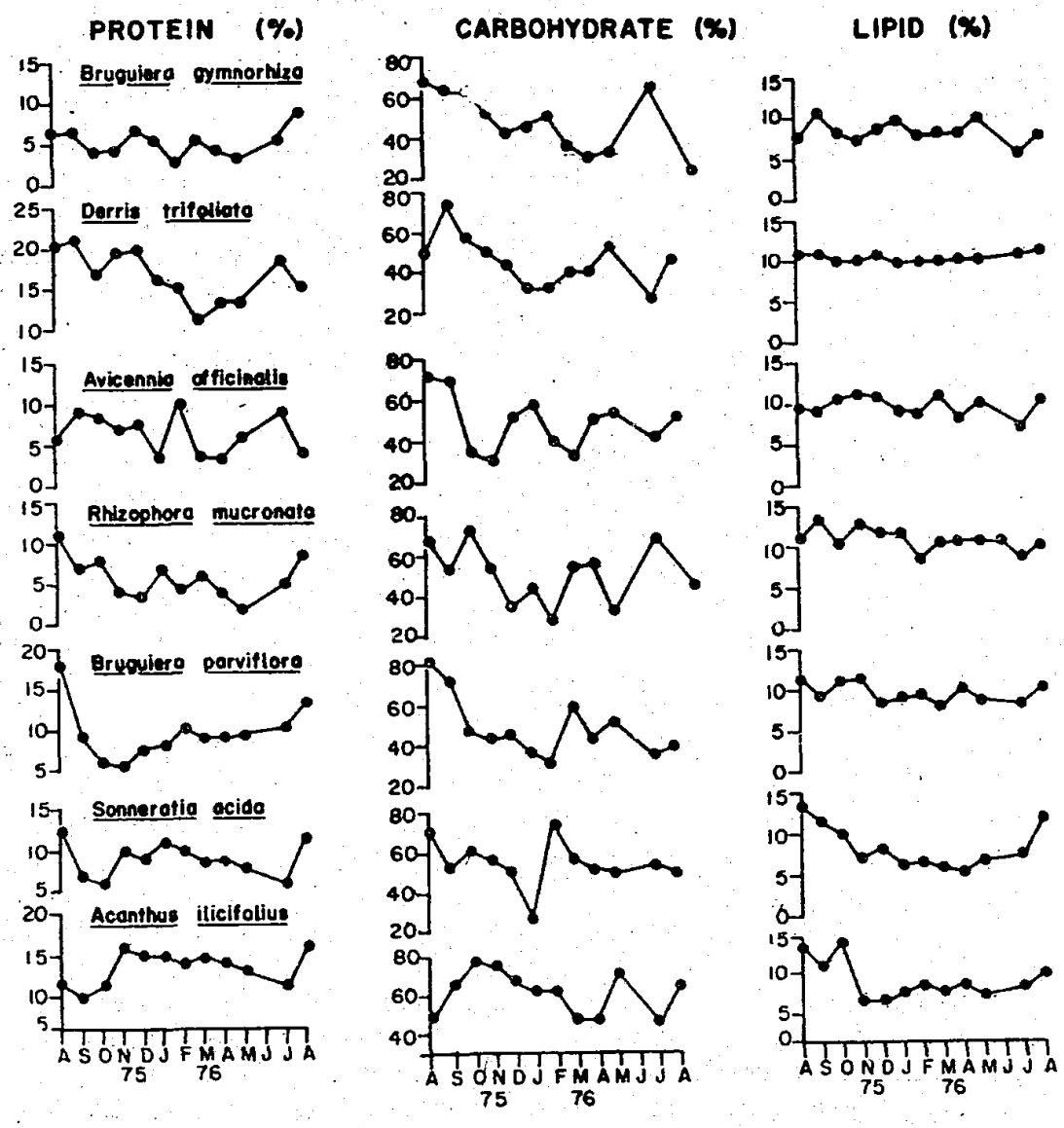

Fig. 1. Seasonal changes in protein, carbohydrate and lipid in mangrove leaves.

The foliage of *B. gymnorhiza, D. trifoliata, R. mucronata* and *B. parviflora* showed negligible seasonal changes in their moisture content. However, in *A. officinalis, S. acida* and *A. ilicifolius* some low values were observed from September to November and from February to April respectively (Fig.2).

Maximum caloric values were recorded in *D. trifoliata* (6.72 kcal/g), *B. gymnorhiza* (6.56 kcal/g), *R. mucronata* (6.53 kcal/g) and *B. parviflora* (6.32 kcal/g) in January. It was obeserved that during the period, January to May, mangrove foliage releases more energy. Among the seven mangrove species investigated, *B. gymnorhiza* showed maximum average value of 5.14 kcal/g followed by *D. trifoliata* (5.09 kcal/g), *A. officinalis* (4.95 kcal/g), *S. acida* (4.93 kcal/g) whereas the other species had lower values (Table I).

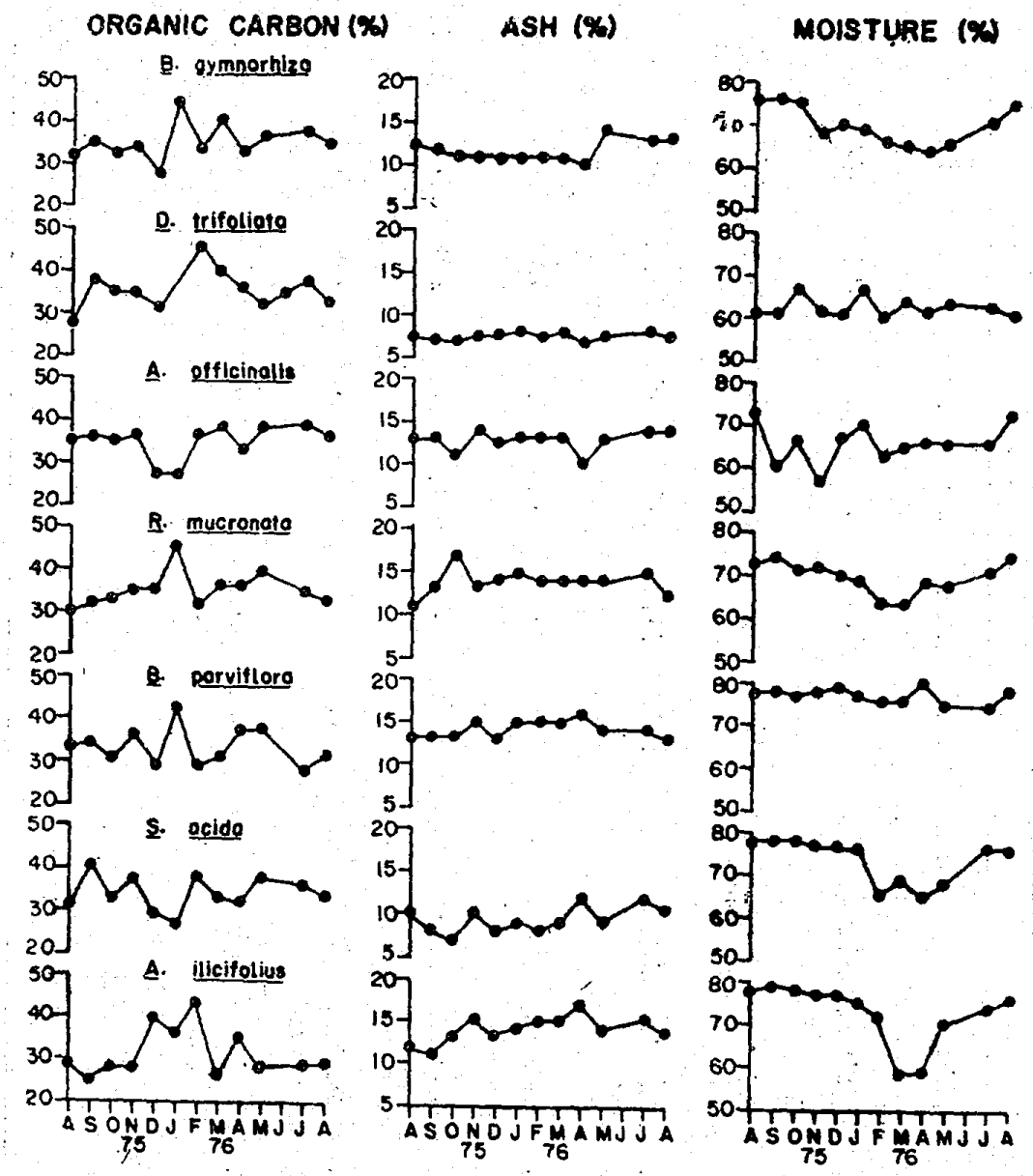

Fig. 2. Seasonal changes in organic carbon, ash and moisture content in mangrove leaves.

Table I. Seasonal variations in caloric values (kcal/g) of seven species of mangroves.

	Species	Aug.	Sept.	Oct.	Nov.	Dec.	Jan,	Feb.	March	April	May	June	July	Mean for 12 months
1.	*Bruguiera gymnorhiza*	4·72	5·03	4·64	4·93	4·08	6·56	4·94	5·94	4·73	5·37	—	5·34	5·14
2.	*Derris trifoliata*	3·97	3·97	5·10	5·21	4·65	6·72	5·91	5·27	4·76	5·06	—	5·38	5·09
3.	*Avicennia officinalis*	5·01	5·19	5·05	5·18	3·80	4·02	5·28	5·56	4·08	5·61	—	5·76	4·95
4.	*Sonneratia acida*	4·45	5·78	4.71	5·38	4·24	3.91	5.53	4·79	4·60	5·58	—	5·24	4.93
5.	*Bruguiera parviflora*	4·79	4·92	4·44	5·20	4·21	6·32	4·18	4·42	5.39	5.38	—	4·12	4.85
6.	*Rhizophora mucronata*	4·24	4·57	4·74	4·99	5·07	6·53	4·58	5·32	5·26	5.84	—	5·12	4·69
7.	*Acanthus ilicifolius*	4·13	3·59	4·02	4·15	5·84	5·24	6·28	3·79	5·07	3·99	—	4·13	4·56

All the seven species investigated showed considerable variation in their major metabolite contents; Sidhu (1963) analysed the ash and sodium content in three species of *Avicennia*. In the present investigation, the range in the ash content was almost similar to that given by Sidhu (1963). Our findings on water content in *R. mucronata* confirm the values recorded by Atkinson, Findlay, Hope, Pitman, Sadder and West (1967). Earlier, Sokoloff, Redd and Dutscher (1950) and Morton (1965) studied the chemical composition of dry leaves of *R. mangle*. However, the general trend of biochemical composition in *R. mucronata* in the present study shows large variations which may be because of wide changes in environmental conditions at Goa.

Mean caloric values observed in the seven species of mangroves appear to be important. Golley (1969) is of the opinion that mangroves have generally more enegry values than other tropical trees. *B. gymnorhiza*, *D. trifoliata*, *A. officinalis* and *S. acida* appear to be nutritionally important. Sokoloff, Redd and Dutscher (1950) and Morton (1965) have suggested the use of mangrove foliage for poultry and cattle feed. The nutritive values of the leaves of mangroves indicate that these could possibly be used for the extraction of leaf protein. The leaves could also be used as green manure in fish farms.

ACKNOWLEDGEMENT

The authors wish to record their sincere thanks to Dr. S. Z. Qasim, Director, National Institute of Oceanography for his criticism on the manuscript.

REFERENCES

Atkinson, M. R., G. P. Findlay, A. B. Hope, M. G. Pitman, H.D.W. Sadder and K. R. West, 1967. Salt regulation in mangroves, *Rhizophora mucronata & Aegialitis annulata*, R. Br. *Australian Journal of Biological Sciences*, **20**: 589–599.

Bhosle, N. B., V. K Dhargalkar, S. G. P. Matondkar, Sayeeda, S. Bukhari, 1976. Biochemical composition of mangrove leaves from Goa. *Indian Journal of Marine Sciences*, **5**(2): 239–241.

Boyd, C. E., 1971. Leaf proteins from aquatic plants. In *Leaf Protein: its agronomy, preparation, quality and use*, edited by N.W. Pirie, IBP Book No. 20, Blackwell & Co., Oxford, p. 44–49.

Fell, J. W., R. C. Cefalu, I. M. Master and A. S. Tallman, 1975. Microbial activities in the mangrove (*Rhizophora mangle*) leaf detrital system. *Proceedings of International Symposium on Biology and Management of Mangrove, Hawaii*, **1**: 661–679.

Golley, F. B., 1969. Caloric values of wet tropical forest vegetation. *Ecology*, **50**: 517–519.

Harrison, P. G. and K. H. Mann, 1975. Chemical changes during seasonal cycle of growth and decay in eel grass (*Zostera marina*) on Atlantic coast of Canada. *Journal of the Fisheries Research Board of Canada*, **32**(5): 615–621.

Macnae, W., 1968. A general account of the fauna and flora of mangrove swamps and forests in the Indo-West Pacific region. *Advances in Marine Biology*, **6**: 73–270.

Morton, J. F., 1965. Can the red mangrove provide food, feed and fertilizer? *Economic Botany*, **19**: 113–123.

Odum, E. P. and A. A. De la Cruz, 1967. Particulate organic detritus in Georgia salt marsh estuarine ecosystem. In: *Estuaries*, edited by G. H. Lauff, American Association for the Advancement of Sciences, **83** : 383–388.

Odum, W. E. and E. J. Heald, 1975. The detritus based food web of an estuarine mangrove community. *Estuarine Research*, **1**(2) : 265–286.

Sidhu, S. S., 1963. Studies on Mangroves. *Proceedings of Symposium on Ecological Problems in the Tropics,* National Academy of Sciences, India, Sect. B, 33:129–136.

Sokoloff. B., J. B. Redd and R. Dutscher, 1950. Nutritive values of mangrove leaves (*Rhizophora mangle*). *Quarterly Journal, Florida Academy of Sciences*, **12**: 191–194.

Untawale, A. G., N. B. Bhosle, V. K. Dhargalkar, S. G. P. Mantondkar and Sayeeda S. Bukhari, 1976. Biochemical changes in mangrove foliage during growth and decomposition. *Indian Journal of Marine Sciences*, 6(1) : 104–106.