Pakistan J. Sci. Ind. Res., Vol. 29, No. 1, February 1986

# BIOCHEMICAL COMPOSITION OF THE MANGROVE, *AVICENNIA MARINA*, FOLIAGE

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(Received June 17, 1985; revised September 12, 1985)

Biochemical analysis of *Avicennia marina* foliage showed that carbohydrate was the major organic metabolite (57.5 g% dry weight).AWC:N ratio of 18.9:1 showed that leaves are deficient in protein. In organic constituents represented 13.46 g% dry weight. The leaves possesed high calorific content (5.68 kcal/g). Seventeen aminoacids were detected. Cystine and aspartic acid were the two dominant amino-acids.

## INTRODUCTION

Mangrove swamps are intertidal communities of plants which proliferate luxuriantly along the deltaic region of the Indus. According to a satellite remote sensing survey it was found that 44% of the total deltaic region is occupied by mangroves [1]. The mangrove leaves are useful contributors to the nutrient system of the mangrove environment [2-5]. It is known that mangrove leaves contain sufficient amounts of minerals, vitamins and aminoacids which are essential for the growth and nourishment of marine organisms and livestock [6-7]. Perry [8] further demonstrated the superiority of mangrove fodder over others because of the presence of common salt and iodine in the former. It was experimentally shown [9, 10] that the livestock fed on mangrove leaves yield milk of better quality and more in quantity [9-10].

A number of studies have been undertaken on biochemical changes in the leaves of Indian mangroves [2, 3, 11]. No such study has been reported on Pakistan mangroves. Saifullah [12] highlighted the general mangrove ecosystem of Pakistan. Mangroves of the Indus region are monospecific in the sense that 99.9% of the forests are composed of *Avicennia marina*. The present communication deals with the detailed biochemical analyses of Karachi mangrove leaves so that their importance in the mangrove ecosystem may be documented for further studies.

## MATERIAL AND METHODS

Fresh leaves of the mangrove plant *Avicennia marina* were obtained from Chari Kund (Sandspit Backwaters) in August 1984. In the laboratory they were washed, weighed and dried at 80°. The dried powder was analysed for water content, moisture and ash [13], organic carbon [14], protein (as nitrogen) [15], lipid [16]. Carbohydrates were not determined but were calculated by difference of sum of protein, lipid and ash from 100%. Sodium, potassium, calcium and phosphorus were determined as described by Hawk *et al* [15].

For aminoacid determination aliquots of hydrolysed samples were analysed on high speed Hitachi-835 amino acid autoanalyser. The calorific value of mangrove leaves was determined by two methods: (a) using calorific equivalents of protein (5.65), carbohydrates (4.15) and lipid (9.45 kcal/g a dry weight); (b) through percent carbon method (Platt [17] in which equation for zooplankton equivalents was applied: Cal/g dry wt. =(152 x % carbon) – 227.

In order to correlate the biochemical components with the individual mangrove leaf, dry weight of eight hundred leaves (average length = 7.48 ± 0.09 cm) were calculated and the results incorporated in the table on per leaf basis. A standard sized mangrove leaf weighed a little under 200 mg dry weight.

## RESULTS AND DISCUSSION

*Organic constitutents.* Biochemical analyses of mangrove (*Avicennia marina*) leaves show that carbohydrates were the major organic metabolites (Table 1). Proteins and lipids were present in rather smaller amounts. Organic carbon amounted to 38.87% of the organic matter. Similarly high values of total nitrogen (2.05%) were recorded. The ratio of carbon to nitrogen is considered as a reliable indicator for the assessment of the nutritive value of food. According to Russell-Hunter (18), a C:N ratio of above 17:1 indicates a low proportion of proteins. It is also stated that the dietry requirement of the proteins of most animals is equivalent to a C:N intake of 17:1 [19]. The

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present data show C:N ratio of 18.9:1. Untawale *et al* [3] working on *A. officinalis* from India reported corresponding C:N ratios. Their values, 26.97 and 20.5 for stages I and II of mangrove leaves, respectively, are, however, a little higher indicating that the leaves of *A. officinalis* from India are of low proportion in protein than *A. marina* from Karachi. Fell *et al* [19] presented the figures of C:N ratio for a number of agricultural crops from which it is evident that C:N ratio of mangrove leaves are lower than those of sugar beets, potatoes and rice but higher than beef and soybean. Further, it was reported that C:N ratios decreased in withered or decomposing leaves [3, 11].

*Amino acid composotion.* Table 3 details the amino acid composition of *Avicennia marina* leaves. On testing against twenty two known amino acids it was found that the hydrolysate of mangrove leaves was positive for seventeen acids.

The amino acids determined may be categorised into two groups, viz. essential amino acids (EAA) and non-essential amino acids (NEAA). Of the 17 amino acids estimated 11 belong to EAA group in which cystein was the major amino acid and next to it was *iso*-leucine. The leaves are very low in valine, threonine and histidine and phenylalanine was represented in traces only. Sulphur-containing amino acids appeared in remarkably high amounts.

A total of six NEAA was detected of which aspartic acid was present in considerable amounts (15.71% protein); next to it were glycine and glutamic acid. It is noteworthy that the concentration of acidic amino acids, aspartic and glutamic, was very high in mangrove leaves compared to alfalfa and cereals [23].

*Inorganic constituents;* Values of inorganic constituents in mangrove leaves are shown in Table 2. Amounts of Na and Ca reported in the present study are similar to those for *Avicennia marina* from India [20]. K values (1.13%) are, however, higher in the present investigation compared to Indian mangrove species. A range of values from 0.31 to 2.58% for K have been reported for leaves of Indian man-

Table 1. Organic constituents from leaves of *A. marina*. (The values in the table are means ± 1 standard deviation

| Parameters | g/100 g dry wt. |
|---|---|
| Water content | 67.79 ± 1.28 |
| Organic matter | 86.54 ± 1.05 |
| Moisture | 5.31 ± 0.73 |
| Protein (N x 6.25) | 12.82 ± 1.05 |
| Lipid | 10.85 ± 0.27 |
| Carbohydrate | 57.56 ± 1.39 |
| Organic carbon | 38.87 ± 0.16 |
| Total nitrogen | 2.05 ± 0.17 |
| C:N ratio | 18.96 |
| Calorific value | |
| (i) Calculated from organic carbon. | 5.68 kcal./g |
| (ii) From metabolite equivalents. | 4.35 kcal./g. |

Table 2. Inorganic constituents from leaves of *A. marina* (The values in the table are means ± 1 standard deviation).

| Parameters | g/100 g dry wt. |
|---|---|
| Inorganic content | 13.46 ± 0.91 |
| Sodium | 3.89 ± 0.05 |
| Potassium | 1.13 ± 0.05 |
| Calcium | 0.31 ± 0.01 |
| Phosphorus | 0.52 ± 0.009 |
| Na : K ratio | 3.44 |
| N : P ratio | 3.94 |

Table 3. Amino acid composition from leaves of *A. marina*. (+ + Traces).

| Amino acids | Value (g/100g protein) |
|---|---|
| Lysine | 2.09 |
| Phenylalanine | ++ |
| Leucine | 1.74 |
| *Iso*leucine | 5.62 |
| Methionine | 4.98 |
| Valine | 0.92 |
| Threonine | 1.66 |
| Histidine | 1.19 |
| Cystine | 21.09 |
| Arginine | 2.85 |
| Tyrosine | 4.50 |
| Glycine | 6.21 |
| Alanine | 3.06 |
| Aspartic acid | 15.71 |
| Glutamic acid | 6.06 |
| Proline | 1.41 |
| Serline | 1.42 |

groves [21]. The value of P in the present study is exceptionally high (0.52%), considering the fact that reported values of P in Indian mangroves are from 0.037 to 0.375% [22]. No definite explanation of this descrepancy may be offered at this stage.

*Calorific value.* Calorific values determined through two methods are shown in Table 1. High energy values of mangrove foilage are recorded. The data show that carbohydrates contributed most to the high energy values compared to proteins and lipids. It may be seen from the table that the calorific values determined from organic carbon (5.69 kcal/g) are higher than those calculated through energy equivalents of major metabolites (4.35 kcal/g) which evidently showed that carbon is present also in forms other than carbohydrates, lipids and proteins. The calorific values reported here compare favourably with those published from Indian mangroves [2, 11]. Sumitra *et al* [11] observed that the decomposition of magrove leaves *(Rhizophora mucronata)* increased the calorific value. During decomposition calorific value increased from 4.23 to 4.73 kcal/g) dry weight in the field and 3.88 to 4.32 kcal/g dry weight in the laboratory.

Lack of some essential amino acids in mangrove leaves rendered their utilization unsuitable as a sole source of protein for domestic animals. However, mangrove foliage may be utilized as a supplementary dietary component, especially due to the presence of sulphur containing amino acids.

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