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# EFFECT OF SEASONAL VARIATIONS ON CHEMICAL COMPOSITION OF MANGROVE VEGETATION OF KARACHI

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Study on the effect of seasonal variation on chemical composition of mangrove leaves and twigs revealed that the period between February and April was ideal for the bio synthesis of different plant constituents. Organic matter, cellulose, nitrogen and protein were observed in high concentrations in leaves than in twigs, whereas the fibre content was greater in twigs. On storage the plant material under investigation deteriorated and resulted in the reduction of the amino acid content. Out of the fifteen and eleven amino acids in leaves and twigs respectively, only five could be detected.

From the above results it appears that mangrove leaves contain more nutritive matter than twigs, and animal feed should be prepared from material collected during the months of February – April. Since the material on storage looses some of its nutritive value, it should not be used for preparing animal feed.

*Key words:* Seasonal variation, Chemical composition, Mangrove.

## INTRODUCTION

The possible use of mangrove vegetation for feeding animals had been postulated by Nathan Mayo in Florida some 35 years ago; similar claims were also made by owners of dairy herds who used mangrove leaves to feed cattle [1].

Arbelaez in 1950 [2] reported that milk yield/pound of protein intake was higher from animals whose diet was supplemented with mangroves. Bhosle [3], Untawale [4], and Samitra [5] reported on biochemical changes in mangrove leaves belonging to different species from Indian region. Recently Rashida Qasim [6] reported on the biochemical composition of mangrove foliage from the coastal area of Pakistan but no study on the chemical composition of other parts of the plant was undertaken.

This is the first attempt to study the effect of seasonal variation of the chemical composition of leaves and twigs collected from mangrove swamps located near Karachi. This study also involves determination of cellulose and lignin contents in order to asses the extent of digestability for use in animal feed. The effect of storage on amino acid profile in mangrove plants as well as a comparison of leaves and twigs with respect to chemical composition was also investigated.

## MATERIALS AND METHOD

Mangrove shrubs (*Avicennia officinalis*) comprising leaves, twigs and stems were collected from forests situated along Kodeero near Rehri village, Karachi. Kodeero creek is part of a network of Korangi creeks with more than 25,000 acres of mangrove forests. Salinity of the ambient water in the creek varies between 2-5%, average age of plant 25 - 30 years and their height 10 - 15 feet. Sample was collected biomonthly by the Divisional Forest Office, Karachi (by random chopping of branches), during four clearly defined seasons, i.e. winter (Nov. – Jan.), spring (Feb. – April), summer (May – July) and fall (Aug. – October). During the experimental year the mean temperature in each season was recorded.

Five kg of whole plant sample was weighed and dried in an oven at 55° to constant weight to determine % moisture [7]. Another 5 kg of the samples was thoroughly washed with tap water to remove mud and dried in an oven as above. Leaves from 5 kg plant were plucked off, weighed, dried and ground together in Moulinex super-blender. The samples size of leaves thus obtained varied between 1.2 – 1.8 kg. Dried twigs being fairly hard were first chopped into small pieces and than powdered together in a rotary grinder, and the size of the twig samples obtained for evaluating chemical composition varied between 1.2 – 1.6 kg. The data are based on 6 samples taken bimonthly for three months. The pH of both samples was measured by pH meter after homogenizing in distilled water. Ash content was determined by igniting the dried materials in a muffle furnace at 600° for 2 hr [8]. Fat was extracted by soxhlet extraction with petroleum ether/(bp. 40-60°) and fibre and organic matter were estimated according to

the method in the FAO Technical Bulletin 27 [9]. Cellulose was determined according to Cross and Bevan [10], and lignin content evaluated using 72% sulphuric acid as suggested by Ritter and Barbour [11]. Total nitrogen was estimated by semi micro-Kjeldahl according to AOAC method [12]. Crude protein was calculated by multiplying the total nitrogen with a factor of 6.25.

Qualitative analysis of mangrove leaves and twigs with regard to amino acids was carried out on freshly plucked material and from stored samples designated as "F" and "S" respectively. Protein isolation, hydrolysis and detection of amino acids was carried out according to the procedure described by Mr. Nazir and M. Saeed [13] on chromatographic paper No. 1, using phenol and distilled water (80:20 V/V) as solvent system.

## RESULTS AND DISCUSSIONS

Low moisture content of plants during summer months suggests water loss through transpiration. During winter and spring the mean temperatures recorded were 21° and 25° respectively. Mangrove plant in these seasons generally had green foliage with tender twigs, whereas during summer and fall months when the mean temperatures were 30 and 28° respectively, leaves not only withered due to relatively high temperatures but also developed black coloured spots. (Fig. 1). Besides morphological differences (as mentioned above) mangrove leaves and twigs also showed variations in quantitative chemical composition.

*Effect of seasonal variation on chemical composition of mangrove leaves and twigs:* During February – April (mean temperature 25°) pH of the leave was close to neutral (6.1), protein comparatively high i.e 12.4% and carbon/nitrogen ratio 18.5/1, whereas during August – October (mean temperature, 28°) the protein value of leave was 9.5% which was the lowest recorded; pH ranged slightly towards acidic i.e 5.6 and the carbon/nitrogen value was highest 24.5/1 (Table. 1). Similar seasonal effects were observed on twigs where during February – April pH value was 6, protein content highest i.e 7.21 % with carbon/nitrogen ratio 26/1; whereas pH value of 5.8, protein 4.1% (the lowest) with carbon/nitrogen value 46.5/1 were noted from August – October.

It is observed from Table 1 that as the weather progressed from cooler to warmer temperatures, lignin and ash percentage gradually increased both in leaves and twigs, organic matter and organic carbon concentrations increased only in leaves but showed slight decline in twigs. Fibre and volatile solids, along with pH value, decreased in summer in leaves and twigs. Cellulose was relatively low in summer in leaves, it reached maximum levels in November – April (42%). However, it was low in twigs between February – October. The highest level was reached in November – January (41.6%). Nitrogen and protein values in both samples were highest in February – April and lowest in August – October. The carbon/nitrogen ratio increases after fall season and reached the minimum value in February – April. As mentioned above during the months of winter – spring, the plant foliage was green and fresh and twigs tender. This seasonal variations in chemical composition is most likely due to the age of the foliage and the twigs of plant; because as the plant grows it increases in lignin content with subsequent decrease in the ratio of other constituents.

From the above results it may be assumed that period between February – April (M.T. 25°) appears to be the ideal time when the nutritive value of mangrove leaves and twigs is at its best. During this time pH value of plant material is towards neutral, protein values highest and carbon/nitrogen values nearest to the dietry requirements of proteins of most animals i.e. equivalent to 17/1 [14]. Lignin content was at its minimum both in leaves and twigs, i.e. 13.4 and 13.6% respectively. With the age of the plant lignin content increases which may affect the digestability.

*Amino acid content of leaves and twigs in fresh and stored samples.* Isolation and hydrolysis of proteins from fresh samples leaves showed the presence of fifteen amino acids (Table 2) including lysine, tyrosine, leucine, methio-

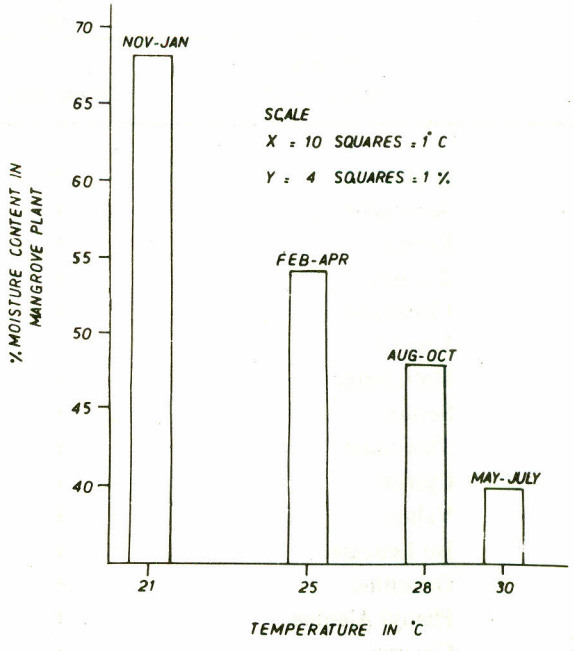


Fig. 1 Effect of temperature on moisture content of mangrove plants

nine, threonine and phenylalanine the essential amino acids. Proteins from fresh twigs on hydrolysis revealed the presence of eleven amino acids including five essential ones such as lysine, tyrosine, methionine, threonine and histidine.

Table 1. Chemical composition of mangrove leaves and twigs in different seasons

| S. NO. | Parameters | Nov. | Dec. | Jan. | Feb. | Mar. | Apr. | May. | June. | July | Aug. | Sep. | Oct. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Leaf | | Twig | Leaf | | Twig | Leaf | | Twig | Leaf | | Twig |
| 1. | pH | 6.1 | | 6.0 | 6.1 | | 6.0 | 5.8 | | 5.7 | 5.6 | | 5.8 |
| 2. | Volatile solids | 85% | | 93% | 85% | | 90% | 85% | | 89% | 84% | | 88% |
| 3. | Ash | 14.8 | | 7.0 | 15.2 | | 9.7 | 15.2 | | 10.7 | 15.8 | | 12.2 |
| 4. | Organic Matter | 64.5 | | 57.3 | 66.8 | | 55.8 | 66.5 | | 55.78 | 66.9 | | 54.5 |
| 5. | Pet. Ether Extractives | 3.5 | | 5.1 | 3.2 | | 3.6 | 3.58 | | 3.5 | 4.9 | | 3.7 |
| 6. | Fiber | 16.8 | | 30.4 | 15.5 | | 31.0 | 14.7 | | 30.0 | 13.7 | | 29.8 |
| 7. | Cellulose | 42 | | 41.6 | 42.24 | | 35 | 40.4 | | 35.78 | 41.3 | | 35.52 |
| 8. | Lignin | 12.5 | | 10.5 | 13.4 | | 13.6 | 15.9 | | 14.6 | 16.1 | | 14.78 |
| 9. | Organic carbon | 35.8 | | 31.8 | 36.5 | | 31.0 | 36.9 | | 30.98 | 37.2 | | 30.27 |
| 10. | Nitrogen | 1.65 | | 0.83 | 1.98 | | 1.18 | 1.63 | | 0.87 | 1.52 | | 0.65 |
| 11. | Protein | 10.3 | | 5.2 | 12.4 | | 7.2 | 10.2 | | 5.4 | 9.5 | | 4.1 |
| 12. | C/N | 21.69 | | 30.35 | 18.5 | | 26 | 22.6 | | 35.6 | 24.5 | | 46.5 |

Based on six samples taken bimonthly for each 3 months.

Table 2. Amino acid content of fresh and stored mangrove leaves and twigs

| S. No. | Standard Amino acids | Leaf | | Twigs | |
|---|---|---|---|---|---|
| | | Fresh leaf | Detoriated leaf stored | Fresh twigs | Detoriated Twigs stores |
| 1 | Arginine | + | – | + | + |
| 2. | Aspergelini | + | + | + | – |
| 3. | Lysine | + | – | + | – |
| 4. | Tyrosine | + | + | + | – |
| 5. | Glutamine | + | – | + | + |
| 6. | Leucine | + | – | – | |
| 7. | Methionine | + | + | + | |
| 8. | Serine | + | + | – | – |
| 9. | Threonine | + | – | + | + |
| 10. | Cystine | + | – | + | + |
| 11. | Valine | + | – | + | – |
| 12. | Iso Leucine | + | – | – | – |
| 13. | Ornithine | + | – | + | – |
| 14. | Phenyl Alanine | + | – | – | – |
| 15. | Glycine | + | + | + | + |
| 16. | Histidine | – | – | + | – |

Analysis of leaves and twigs samples from stored plants showed drastic reduction in protein content. Only five amino acids where detected from leaves and twigs (Table 2).

*Comparative study of leaves and twigs.* As February – April according to the above results happen to be the ideal period when nutritive value of mangrove plant was at its best, it was selected for comparing and evaluating the nutritive quality of leaves and twigs for use in animal feed. Lignin percentage and pH value was almost equal in leaves and twigs. Ash, organic matter, cellulose, organic carbon, nitrogen and protein, the basic requirements for preparing nutritive animal feed are present in higher concentrations in leaves than in twigs; the fibre which is only a source of roughage or filler in animal feed is also 50% less in leaves than in twigs (Fig. 2). It may, therefore, be presumed that mangrove leaves are more nutritive than twigs for animal feed. This is supported by the fact that more amino acids are present in leaves than in twigs; and also by comparing the carbon/nitrogen values of both. The 18.5/1 carbon/nitrogen ratio in leaf is more towards the normal dietry value of animal than that of twig which is 26/1.

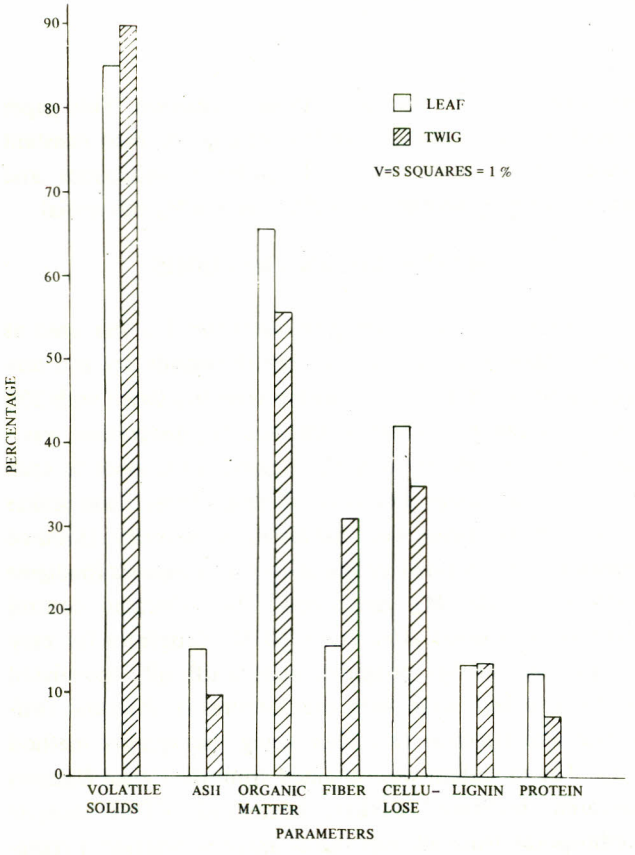


Fig 2. Effect of chemical composition of mangrove leaves and twigs in fall season – A comprison.

It may, therefore, be concluded that mangrove leaves are more nutritive and also that feed for animals should be prepared from mangrpvd leaves when the foliage is fresh and young, preferbly during the February – April period, it was also observed that leaves should be processed immediately for preparing the feed, as stored leaves result in the loss of amino acids due to deterioration.

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