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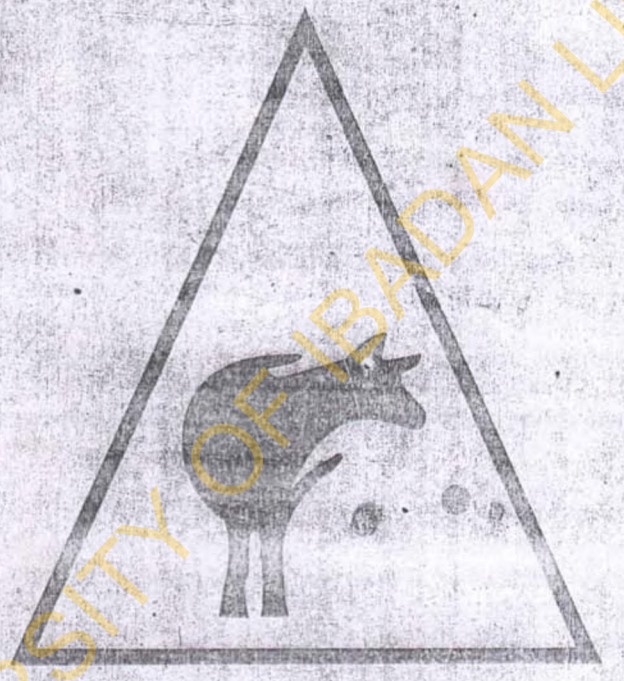

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Proximate Chemical and Fatty Acid Composition of Leaves, Fruit pulp and Seeds of Apple-Ring Acacia (*Acacia albida* Del.) from North-Eastern Nigeria

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INTRODUCTION. Acacia albida Del., a leguminous tree, is one of the largest of the Acacia trees in Africa (Skerman, 1977) and the largest of the Acacia in Nigeria (Keay, 1989). It is a common feed resource in the semi-arid and arid regions of Nigeria. All farm animals except horses relish the leaves and pods of this plant (Göhl, 1981). The plant remains leafless during the rains but produces fresh foliage during the dry season. This unique inverted phenology makes it possible for livestock to survive on this plant during the 4-6 months spell of dry season when feed is scarce. Migrant livestock handlers often lop the leaves and ripe and mature pods for feeding their stock. A full grown tree can produce up to 100 kg of pods per year (Göhl, 1981). However presence of tannins depresses protein and organic matter digestibility (Barry and Manley, 1984). Some species of Acacia contain the potentially toxic cyanogenic glucosides (Maslin *et al.*, 1986). This study was carried out to investigate the chemical composition, minerals and fatty acid fractions of the leaves, fruit pulp and seeds of the Acacia albida.

MATERIALS AND METHODS Mature leaves and ripe fruits of Acacia albida were harvested in the month of February 1996 from the University of Maiduguri, Borno State, Nigeria. Samples were taken for dry matter determination and the remaining samples were dried at 60°C for 24 hr. The pods split and the seeds, fruit pulp and the leaves milled separately. These samples were then stored in air-tight sample bottles until ready for chemical analyses.

Proximate analysis

Moisture, protein, and crude fibre contents were determined according to the methods of AOAC (1980). The total fat was extracted with petroleum ether using Soxhlet extraction method for 12 hr. The ash was determined gravimetrically by burning the oven dried material at 660°C for 6 hr. 100 mg of the samples were digested with 5 ml of salicylic acid/H_2SO_4 mix at 370 C for 4 hr. Li_2SO_4 and $CuSO_4.5H_20$ in 10g: 1g was used as catalyst. Concentrations of Ca, Total P, Mg, Zn, Fe and K in the ash were determined by using flame atomic absorption spectrophotometer (Perkin Elmer).

Total lipids

The method of Marsh and Weinstein (1966) was applied for total non specific lipid determination. The lipid extraction was base on Christie, (1993) method and washed according to the method of Folch *et al.* 1957. 20 µl of each lipid extract and, for the calibration curve, of standard solutions of 0, 10, 20, 30, 40, and 50 mg/ml of olive oil in chloroform were transferred to pairs of thick-walled test tubes. The solvents were removed under a flow of nitrogen. After evaporation of the solvents, 2 ml of concentrated sulphuric acid was added to each tube, mixed then heated for 15 min in an oven pre-set at 200°C . The tubes were cooled in an ice bath for 5 min, then 3 ml of distilled water was carefully added to each tube and mixed thoroughly. The tubes were removed from ice and left standing for 10 min until all bubbles had disappeared. The optical density was measured with a CECIL CE 1020, Series 1000 spectrophotometer at 375 nm.

Fatty acid analysis

Fatty acid methyl ester (FAME) derivatives were prepared using methnolic based reagent directly from total lipid extracts.

Gas chromatography of the samples was performed using a Varian 3500 gas chromatograph equipped with 8300 auto injector, Australia. The generating conditions were: A 30 x 0.25 mm 30 m silica column (DB-23, J and W scientific, USA). The column was heated from 140°C to 240°C at 6°C min-1 with injector set at 275°C and flame ionisation detector (FID) set at 275°C. The carrier gas was nitrogen. Standard FAME samples of fatty acids were injected in the column for identification of fatty acids from the samples against their retention times. The results showed the amount of each fatty acid as a percentage of the total fatty acids in the samples. Pure fatty acids standard (Oil reference standard, AOCS for low Erucic Rapeseed oil, Sigma, 1 amp (100 mg) Lot 65H83681) dissolved in hexane were used as standards. 1µl of the extract diluted in hexane was injected.

RESULTS AND DISCUSSION. Proximate chemical composition of the leaves, fruit pulp and seeds are shown in Table 1. The leaves, fruit pulp and seeds contained (on dry matter basis) 156.8, 95.55 and 319.3 g Kg^{-1} crude protein respectively while values for crude fibre contents were 168.2, 246.85 and 12.25 g Kg^{-1} respectively. The fruit pulp and leaves were high in crude fibre while the seed contained low crude fibre content. The carbohydrate fractions of the samples do not seem to vary from one another.

Table 2 shows the mineral composition of the leaves, seeds and fruit pulp. Comparatively the leaves were richest in Calcium and Iron but higher in total phosphorus than the fruit pulp. However the seeds were highest in Magnesium, Zinc, Potassium and total Phosphorus.

The fatty acid compositions are shown in Table 3. An unidentified fatty acid (C*) constituted the highest amounts in the leaves (65.83%), fruit pulp (89.07%) and (69.01%) in all the samples. The leaves were highest in C14:0, C16:0, C18:0 and C18:3 while the seeds were best sources of C18:2. The C16:0 and C18:2 fatty acids were of importance in the pods (fruit pulp). Generally all the samples were low in fatty acids in the range of C20 to C22 but C22:1 (Erucic acid) is of more importance in the seeds than in the leaves and fruit pulp. The presence of high Erucic acid in the seeds is of nutritional importance in consuming animals. Lignoceric acid (C24:0) did not vary significantly in the samples. The seeds contained more unsaturated fatty acids than the leaves and fruit pulp. The unsaturated: saturated fatty acid ratio obtained were 1.03, 0.77 and 2.18 for leaves, fruit pulp and seeds respectively.

Except for crude fibre the fruit pulp did not show superiority in all other parameters and consequently the pod may be of low nutritional value to livestock. Milled pods with seeds provided a supplement equal in superiority to maize bran than the unmilled forms (Goodchild, Unpublished). Previous studies have also implicated high levels of tannins and/or high lignin content in the leaves as a major factor limiting their utilisation for livestock feeding (McMeniman *et al.*, 1981 and Göhl, 1981). Oral applications of polyethylene glycol (PEG) to sheep at the rate of 8g per head per day have been found to improve protein digestibility (Pritchard *et al.*, 1985).

CONCLUSION

The acacia leaves and pods are a popular feed resource in the semi-arid and arid regions of Nigeria. The inverted phenology exhibited by the plant makes it unique in this respect. The leaves and pods are good sources of protein and fibre in the diets of monogastrics and ruminants. However the presence of tannins and cyanogenic glucosides in some species of Acacia limits its efficient utilisation in livestock feeding. It is therefore imperative that the processing of acacia will be a major way towards improving its nutritive value as animal feed resource. At the University of Maiduguri studies are presently been conducted on the utilisation of steam-treated acacia pods in rabbit feeding.

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TABLE: 1 Moisture (g Kg^{-1}), and Chemical composition (g Kg^{-1} of dry matter) the leaves, fruit pulp and seeds of *Acacia albida*

*Components	Leaves	Fruit pulp	Seeds
Moisture	107.70±10.22	104.40±9.2	91.22±5.6
Crude protein	156.8±15.36	95.55±3.59	319.30±25.20
Crude fibre	168.20±11.60	246.85±21.33	12.25±0.20
Ether extractives	54.20±2.22	6.24±0.15	32.12±1.24
Total lipids	119.9±12.35	45.61±0.25	96.31±5.37
Carbohydrate	510.10±12.44	547.26±10.42	545.11±9.42
Ash	69.10±2.55	34.19±1.58	34.03±2.66

* Values obtained are means of triplicate experiments.

TABLE: 2. Mineral composition of leaves, fruit pulp and seeds of *Acacia albida* (mg Kg^{-1})

*Components	Leaves	Fruit pulp	Seeds
Calcium	6672.11±125.23	3825.74±202.24	2995.55±15
Magnesium	1193.25±86.2	532.70±14.22	2663.91±10[illegible]6
Iron	146.11±6.12	4.30±0.11	33.51±2.50
Zinc	12.00±0.25	3.57±0.21	32.74±1.28
Sodium	230.0±10.28	34.71±1.85	39.62±2.41
Potassium	6289.0±101.36	10778.6±104.25	12249.6±240.28
Total phosphorus	1136.0±25.36	1001.0±24.35	4220.25±24.36
Ca: P	5.87	3.82	0.71

* Values obtained are means of triplicate experiments.

TABLE: 3. Fatty acid composition (% of total fatty acid), of leaves, fruit pulp and seeds of Acacia albida.

Fatty acids	Leaves (%)	fruit pulp (%)	Seeds (%)
C*(Unidentified)	65.83	89.07	69.01
C14:0	1.11	0.62	0.19
C16:0	11.29	3.89	6.80
C18:0	3.11	0.66	1.59
C18:1	1.75	1.31	7.17
C18:2	3.93	2.37	12.98
C18:3	11.38	0.68	0.19
C20:0	0.47	0.22	0.37
C20:1	0.21	0.26	0.35
C22:0	0.48	0.41	0.46
C22:1	0.10	0.25	0.38
C24:0	0.35	0.37	0.33
O/L	0.45	0.55	0.55
U/S	1.03	0.77	2.18

O/L, Oleic/Linoleic; U/S, Unsaturated/Saturated
* Values obtained are means of triplicate experiments.

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