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Nutritional composition of *Prosopis chilensis* (Molina) Stuntz leaves and pods from Sudan

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Analyses of the proximate, nutritionally valuable minerals and amino acids compositions in pods and leaves of *Prosopis chilensis* were carried. Dry leaves and pods contained 32.2% and 12.5% protein, 52.6% and 53.0% carbohydrate, 4.1% and 2.5% lipid, 18.5% and 27.5% crude fibre, 12.6% and 4.9% ash, 4.8% and 6.1% moisture respectively. The pods showed higher amount of most essential amino acids than the leaves and fulfil the requirements of the FAO/WHO 'standard protein'. Mineral ranges (mg/100g dry weight) in leaves and pods were: P (250 and 164), K (116 and 191), Na (1.0 and 4.0), Ca (276 and 26), Mg (28 and 94), Fe (9.0 and 3.0) and Mn (1.0 and 1.0) respectively. Comparing these values with recommended dietary allowances, the results indicated that *P. chilensis* could be a good supplement for some nutrients.

Key words: *Prosopis chilensis*, proximate analysis, amino acids, minerals.

INTRODUCTION

Large segments of population in the developing countries suffering from malnutrition. Projection based on current trends indicates a gap between human population and food supply. Hence research efforts are being directed to this area to identify and evaluate under exploited sources as alternative crops for the world of tomorrow (Egbc and Akinyete, 1990). In this regard, various studies are being carried out to assess the potential of indigenous plants that are not widely used as food as dietary source of proteins, vitamins, minerals.etc (Burlingame, 2000; Vadivel and Janardhanan, 1999; FAO, 1997).

The genus *Prosopis* comprises about 44 species mainly of American and a few of Asian distribution and in arid and semi-arid areas of North and South Africa (Elsidig et al., 1998). *Prosopis chilensis* (Molina) Stuntz (Mesquite) was introduced in the Sudan by the government botanist Massy in 1917. The seeds were procured from South Africa and Egypt. Since that time, the tree has been planted in various localities in Sudan (Elsidig et al., 1998).

In contrast to their undesirable effects as invasive weeds, many *Prosopis* species are valuable multipurpose resources in their native range, providing

timber, firewood, livestock feed, human food, shade, shelter and soil improvement (Pasicznik et al., 2001). In Sudan, pods have become less important as a human food and more important as a livestock feed during the last few centuries. Africans believe that, the ripe pod makes excellent fodder but the green pod is bitter and valueless (Watt and Breyer-Brandwijk, 1962). In this context, analyses were carried out to evaluate the nutritional content of *P. chilensis* pods and leaves with hope that it could be a beneficial nutrient source for human and animal consumption especially in developing countries where poverty and climatic changes are causing havoc to the rural populace.

EXPERIMENTAL

Plant material

Fresh leaves and pods of *P. chilensis* were collected from Shambat- Khartoum State of Sudan. Species was authenticated at the Herbarium of Environment and Natural Research Institute (ENRRI), National Centre for Research (NCR) where voucher specimens were deposited.

Both leaves and pods were dried separately at room

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Table 1: Proximate composition of *Prosopis chilensis* leaves and pods (Expressed as (%) on DW basis)

	Leaves*	Pods*
Moisture	4.8 ± 11.2	6.1 ± 14.0
Crude fibre	18.5 ± 2.2	27.5 ± 2.4
Crude protein	32.2 ± 3.2	12.5 ± 1.5
Ash	12.6 ± 3.0	4.9 ± 1.8
Ether Extract	4.1 ± 0.7	2.5 ± 0.9
Carbohydrate (NFE by difference)	52.6 ± 1.1	53.0 ± 1.4

* Results are the mean ± SD of three determinations

temperature, ground into coarse particles by using pestle and mortar and kept until required.

Proximate analysis

Proximate analysis of the sample's moisture content, ash, ether extract and fibre content were done using the method reported by AOAC (1990). Nitrogen was determined by the micro-Kjeldahl method reported by Pearson (1976) and crude protein content was subsequently calculated by multiplying the nitrogen content by a factor of 6.25. Carbohydrate content was estimated by subtracting the sum of the weights of protein, fibre, ether extract and ash from the total dry matter and reported as nitrogen-free extractives (NFE by difference). All determinations were in triplicates.

Essential and non-essential amino acids

Amino acid composition of samples was measured as hydrolysate using an amino Acid Analyzer (Sykam-S7130) based on high performance liquid chromatography technique. Sample hydrolysis was prepared following the method of Moore and Stein (1963). 200 mg of sample were taken into a hydrolysis tube. 5 ml 6 N HCl were added to the sample. The tube was tightly closed and incubated at 110° C for 24 h. After incubation period, the solution was filtered and 200 µl of the filtrate were evaporated to dryness at 140 ° C for an hour. The hydrolysate was diluted with one ml of buffer (citrate buffer pH 2.2). Aliquot of 150 µl of sample hydrolysate was injected in cation separation column at 130 ° C. Ninhydrin solution and an eluent buffer (the buffer system composed of solvent A of pH 3.45 and solvent B of pH 10.85) were delivered simultaneously into a high temperature reactor coil (16 m length) at a flow rate of 0.7 ml/min. The buffer/ninhydrin mixture was heated at 130° C for 2 min to accelerate chemical reaction of amino acid with ninhydrin. The products of the reaction mixture were detected at wavelength of 570 nm (440 nm for proline) on a dual channel photometer. The

amino acids were identified by their retention time and wavelength ratio calculated from the areas of standards obtained from the integrator and expressed as g/100 g.

Mineral analysis

The methods used in the present work were described and recommended by Perkin Elmer (1996). Minerals were analyzed by dry-ashing 1 g of the sample at 550° C in a furnace. The ash obtained was dissolved in 10% HCl, filtered through an acid-washed filter paper and made up to standard volume with dionised water. Sodium, potassium, calcium, magnesium, manganese and iron contents were determined using atomic absorption spectrophotometry (Perkin Elmer A100). Phosphorus content was determined by employing the method reported by Vanado Molybdate and read on CECIL CE 3041 colorimeter (AOAC, 1990). All determinations were in triplicates.

RESULT AND DISCUSSION

The result of the proximate composition of *P. chilensis* was shown in Table 1. The moisture and crude fibre content of the pods (6.1% & 27.5 %) were found to be higher when compared with the leaves (4.8% & 18.5%). The moisture content was quite low which may be advantageous in view of the sample's shelf-life. Contrary, the crude protein (32.2%), ash (12.6%) and ether extract (4.1%) content of the leaves were found to be higher when compared with that of the pods (12.5%, 4.9% & 2.5% respectively). The high carbohydrate content of *P. chilensis* leaves (52.6%) and pods (53%) make them a good quality food. This result was in accordance with those obtained by Lamarque and Guzmán (1997) who analysed ten *P. chilensis* populations from different phytogeographic areas of Argentina for their proximate and fatty acid composition. Oil and protein contents varied between 2.5–6.6% and 29.2–38.6%, respectively. Ash content ranged from 3.1 to 4.6%. Moreover, Astudillo *et al.* (2000) assessed the proximate compositions of the

Table 2. Essential and non-essential amino acids composition of acid hydrolysed (g/100g weight) of *P. chilensis* leaves and pods

Amino Acid	Leaves*	Pods*	Human requirement**
Threonine	2.81 ± 0.07	8.81 ± 0.12	0.9
Valine	7.11 ± 0.09	13.76 ± 0.01	1.3
Cystine	0.85 ± 0.10	1.75 ± 0.05	
Methionine	1.31 ± 0.06	3.14 ± 0.07	2.2
Met + Cys	2.16 ± 0.08	4.89 ± 0.06	1.7
Isoleucine	4.51 ± 0.04	10.41 ± 0.05	4.2
Leucine	8.25 ± 0.11	19.07 ± 0.09	1.9
Tyrosine	1.73 ± 0.09	4.87 ± 0.07	2.8
Phenylalanine	3.20 ± 0.08	12.54 ± 0.11	2.8
Tyr + Phe	4.93 ± 0.09	17.41 ± 0.09	1.9
Histidine	4.44 ± 0.06	9.66 ± 0.15	1.6
Lysine	2.94 ± 0.08	14.75 ± 0.3	1.6
Aspartic acid	8.88 ± 0.12	21.48 ± 0.14	
Serine	2.04 ± 0.13	6.72 ± 0.11	
Glutamic acid	7.87 ± 0.08	18.56 ± 0.11	
Glycine	1.98 ± 0.12	9.66 ± 0.13	

* , Results are the mean ± SD of two determinations; **, FAO/WHO (1991).

Table 3. Concentration of Trace elements (mg/100 g) of *P. chilensis* leaves and pods

Element	Leaves*	Pods*
Na	01 ± 0.01	04 ± 0.21
K	116 ± 0.11	191 ± 0.02
Ca	276 ± 0.22	26 ± 0.21
Mg	28 ± 0.01	94 ± 0.23
P	250 ± 0.11	164 ± 0.21
Mn	01 ± 0.10	01 ± 0.01
Fe	09 ± 0.10	03 ± 0.21

* Results are the mean ± SD of three determinations

leaves and pods of *P. chilensis* and *P. tamarugo* and the leaves of *P. alba*. They found that, the best protein source reported among these forage trees was the leaves of *P. chilensis*. Díaz Celis (1995) has studied the Peruvian species *P. pallida* and *P. juliflora* as whole fruits for animal feeding. Ranges reported as; protein 9-12%, fibre 14-23%, ash 3-5% and less than 1.7% fats. Pods of *P. juliflora* from Ecuador were reported to have almost identical composition with exception of slightly more fibre (Marangoni and Alli 1988). However, Figueiredo (1975) reported higher levels of protein (15%) and fat (4.9%) for *P. juliflora* pods from North East Brazil. The protein content for most species and provenances was approximately 10%. Although the values for fibre were strongly dependent on the analytical method used, it may be assumed that Peruvian *Prosopis* pods were less fibrous than other species. Proximate analyses of whole pods of several other *Prosopis* species were also reported. For example, Del Valle et al. (1987) reported 11% protein, 29% fibre, 4.6% ash and 1.7% fat for whole pods of *P. glandulosa* and *P. velutina*.

Fourteen amino acids were present in both plant components, the pods revealed the highest value, two or

three folds that of the leaves, for all the amino acids detected. The amount of essential amino acids in leaves and pods of *P. chilensis* was compared to the F.A.O. reference pattern (Table 2). In fact, the essential amino acids present in the pods and leaves fulfill the requirements of the FAO/WHO 'standard protein'. Choge et al. (2007), found that pulp from Kenyan *P. pallida* pods contained nearly all the essential amino acids which present in amounts fulfil the requirements of the FAO/WHO 'standard'. The amino acid compositions of the leaves and pods of *P. chilensis* and *P. tamarugo* and the leaves of *P. alba* have been assessed by Astudillo et al. (2000). According to their amino acid profiles, all species surveyed are deficient in essential amino acids. However, lysine is one of limiting amino acids in grains, thus a point of interest is that, the amino acids of *P. chilensis* pods could serve as a supplemental source to improve the nutritional quality of grain protein.

The mineral elements composition of *P. chilensis* leaves and pods was shown in Table 3. The result showed that calcium had the highest concentration in the leaves, (276 mg/100 g) while potassium recorded the highest value of (191 mg/100 g) in the pods. Potassium of

the leaves averaged (116 mg/100 g). The next abundant mineral elements in the leaves and pods were phosphorus (250 and 164 mg/100 g respectively). Magnesium content was high in both the leaves (28 ± 0.01 mg/100 g) and pods (94 mg/100 g). From the nutritional point of view, content of Mg, an element essential for the right course of many biochemical processes in human organism, is especially valuable. Iron content was 09 and 03 mg/100 g for the leaves and pods respectively, whereas, the value of manganese in both organ was 1 mg/100 g.

The results suggests that the plant if consumed in sufficient amount could contribute greatly towards meeting human and animal nutritional requirement for normal growth and adequate protection against diseases arising from malnutrition. Further investigation into possible toxic and antinutrient factors, digestibility, is still required before recommendations are made.

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