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EFFECT OF SOAKING ON THE NUTRITIONAL VALUES OF KORDALA (*Maerua Pseudopetalosa*) SEEDS GROWN IN KORDOFAN REGION, SUDAN

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ABSTRACT

The aim of this study is to eliminate the alkaloids from Kordala (*Maerua pseudopetalosa*) by soaking process and examine their effect on nutritional value, protein digestibility and anti- nutritional factors. The seeds were soaked in water for seven days with water changed daily. The proximate composition, protein digestibility, minerals composition, anti-nutritional factors and amino acids profile were examined. The results obtained showed that soaking decreased protein content (from 21.67 to 11.64 %), ash (from 2.9 to 0.3%), fat (from 1.78 to 1.05%), polyphenols (from 170.82 to 160 mg/100g), phytic acid (from 743.5 to 588.9 mg/100g), minerals and amino acids content also decreased. The process increased moisture content (from 8.3 to 9.62%), fiber content (from 1.36 to 4.27%), total carbohydrates (from 63.99 to 73.12%) and protein digestibility (from 58.4 to 68.1%) for raw and soaked seeds, respectively. Comparing these values with recommended dietary allowances, the results indicated that Kordala (*Maerua pseudopetalosa*) seeds could be a good supplement source for some nutrients.

Contribution/ Originality: The present study is one of the first reports concerning investigations on the nutritional values of Kordala (*Maerua pseudopetalosa*) and studding the role of soaking on the removal of bitter taste in Kordala, which used in Sudan as famine food.

1. INTRODUCTION

Kordala (*Maerua pseudopetalosa*) is a wild herb grows in Western Sudan during rainy season and their seeds are use as food during food scarcity by the natives. Bell (1995) reported that for many years the importance of wild plants in subsistence agriculture in the developing world as a food supplement and as a mean of survival during times of drought and famine has been overlooked. Generally, the consumption of such so-called 'wild-food' has been and still under-estimated. This may very well be the case for Ethiopia, a so called 'biodiversity hot-spot' and known as a centre of origin for a significant number of food plants. According to Abdelmuti (1991) during the famine at 1984 in Kordofan and Darfur, most of the people depended on famine foods, which contain high protein, carbohydrate, fat and minerals. In developing countries starch-based foods are major sources which supply energy and protein requirements. Thus protein deficiency prevails among the problems recognized by the Food and Agricultural Organization (Ladeji *et al.*, 1995). The protein quality of a food or feed depends on its amino acid composition and its digestibility.

Protein digestibility primarily determines the availability of its amino acids (Hahn *et al*., 1981). Soaking decrease tannins from 0.23% to 0.09% after 48h soaking (Nwosu, 2010). Soaking decreased fat from 6.90% to 6.45%, calcium from 72.5mg/100g to 70.6 mg/100g, Iron 12.6mg /100g to 11mg/100g, Zinc from 6.95mg /100g to 6.80mg/100g, phytic acid 588.2 mg/100g to 535.1mg/100g and polyphenols 148.26 mg /100g to 130.15mg/100g but it improved the protein digestibility from 58.5% to 60.75% in Fenugreek (*Trigonella foenum graecum L*) (Shalini and Sudesh, 2003). According to Mubarak (2005) soaking decreased most of essential amino acids, minerals (Na, K, Ca, P, Mg, Fe, Mn), crude protein, fat, fiber, ash, tannins and phytic acid, and improved in total carbohydrate and moisture in bean seeds (*Phaseolus aureus*). According to Aarti *et al*. (2002) soaking decreased phytic acid according periods of soaking from 6 to 28%, Ca 5 to11% and Fe 2 to 3%.

2. MATERIALS AND METHODS

2.1. Sample Preparation

Kordala (*Maerua pseudopetalosa)* fruit samples harvested from Kordofan region. Fruit samples cleaned and peeled to remove their coats. Samples divided into two portions; one soaked in water for seven days with changing steep water daily and the remaining portion left raw without soaking. After soaking seeds are drained and dried in the sun. The soaked and untreated fruit samples were milled using electric mill to pass through 0.5mm mesh size and stored in a clean dry air-tight containers until the analysis.

2.2. Proximate Composition:

Each of composite samples was pooled and proximate analysis was carried out to determine moisture, crude protein, ash, crude fat and total carbohydrate. The recommended methods of the Association of Official Analytical Chemists were doped. The AOAC method numbers were 14.004, 2.057, 14.006 and 7.062 for moisture, crude protein, ash and crude fat.

Moisture content was obtained by heating three 5.0g portions of each of the samples to a constant weight in a hot air- circulating oven at 1050C for 24hr. Crude protein (%N x 6.25) was obtained by the Kjeldahl method in which nitrogen was determined and % Nitrogen multiplied by a factor of 6.25 to obtain % protein. The method involved the digestion of three 1.0g samples with concentrated tetraoxosulphate (VI) acid, H_2SO_4, the distillation of the digest to liberate ammonia (NH3) which was trapped into 2.0% boric acid solution. This was followed by titration with 0.10M HCl and titer value used to calculate percent nitrogen. Ash was determined by the incineration of three 1.0g samples in a muffle furnace at 6500C for 3h. Crude fat was obtained by exhaustively extracting three replicates of 10.0g samples in the Soxhlet apparatus using petroleum ether (bp 40-600C). Total carbohydrate was calculated by the difference method (summing the values of moisture, crude protein, ash and crude fat and subtracting the sum from 100).

2.3. Mineral Analysis

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

2.4. In Vitro Protein Digestibility Determination

The *in vitro* protein digestibility was determined according to the method of Maliwal (1983) as described by Monjula and John (1991) with a minor modifications. A known weight of the sample containing 16mg nitrogen was

taken in triplicate and digested with 1mg pepsin in 15 ml of 0.1 M HCl at 37°C for 2 h. The reaction was stopped by addition of 15ml of 10% trichloroacetic acid (TCA), and then the mixture was filtered quantitatively through Whatman No. 1 filter paper. The TCA soluble fraction was assayed for nitrogen using the micro-Kjeldahl method (AOAC, 1984). Digestibility was obtained by using the following equation:

$$\text{Protein digestibility \%} = \frac{\text{N in supernatant-enzyme N}}{\text{N in sample}} \times 100$$

2.5. Anti–Nutritional Factors (Total Polyphenols, Phytic Acid and Tannic Acid)

Phenolic compounds were determined using the Prussian Blue assay, as described by Price and Butler (1977). Tannic acid was used as a reference standard, while Phytates of the samples were determined according to the method of Wheeler and Ferrel (1971) and total tannins were determined colorimetrically as described in AOAC (1990).

2.6. Essential and Non-Essential Amino Acids

Amino acids were determined using a Mikrotechna AAA881 automatic amino acid analyzer Model 118/119 CL, Czech Republic) according to the method of Moore and Stein (1963). Hydrolysis of the samples was performed in the presence of 6 M HCl at 110°C for 24 h under a nitrogen atmosphere. Sulfur-containing amino acids were determined after performic acid oxidation. Tryptophan was chemically determined by the method of Miller (1967).

3. STATISTICAL ANALYSIS

For the purposes of the comparing the parameters between raw and soaked kordala seeds SPSS 16.00 (Statistical Packages for Social Sciences) was used to analyze the data using ANOVA test and Duncan Multiple Range test (DMRT) for mean separation.

4. RESULTS AND DISCUSSION

Table 1 showed proximate composition and *in vitro* protein digestibility of raw and soaked kordala (*Maerua pseudopetalosa)* seeds. Moisture content of soaked seeds (9.62%) was higher than untreated seeds (8.3%) Crude fiber in soaked seeds (4.27%) was highest than crude fiber (1.36%) in raw seeds and total carbohydrate (73.12%) in soaked seeds highest than total carbohydrate in raw seeds these differences in fiber and total carbohydrate ratio does not mean an increase in these components, but a decrease in others components. Crude protein (11.64%) in soaked seeds lower than crude protein (21.67%) in raw seeds, ash(0.3%) in soaked seeds lower compared to (2.9%) in the raw seeds. The fat (1.05%) in soaked seeds lower than (1.78%) in raw seeds. The decrease in crude protein, fat and ash during soaking indicate removal these components by water during soaking. These results in agreement with Mubarak (2005) who reported that the soaking of bean seeds (*Phaseolus aureus*) in water decreased crude protein, fat and ash, but different in fiber content. Also soaking increased protein digestibility (68.1%), when compared with protein digestibility (58.4%) in raw seeds. The findings in agreement with Shalini and Sudesh (2003) who reported that soaking improved protein digestibility in Fenugreek (*Trigonella foenum graecum L*) from 58.5 to 60.75%.

The total minerals contents in raw and soaked of Kordala (*Maerua pseudopetalosa*) seeds were summarized in table (2). Results revealed that the soaking decreased the minerals contents in Kordala (*Maerua pseudopetalosa*) seeds, Na (5.66 – 4.65mg/100g), K(250.8– 23.4mg/100g), Ca(0.66 - 0.47mg/100g), Mg (16.6 - 9.31mg/100g), Mn (0.09 – 0.08mg/100g), Fe (2.54 – 0.09 mg/100g), Cu (0.28 – 0.21mg/100g), Zn (2.08 – 1.42mg/100g) and P (3.05 – 2.05mg/100g) for raw and soaked seeds, respectively. The reduction in minerals contents attributed to the removal of minerals during soaking. These results were agreement with Mubarak (2005) who showed that soaking decreased minerals (Na , K , Ca, P, Mg, Fe , Mn).

The anti-nutritional factors of raw and soaked seeds of Kordala *(Maerua pseudopetalosa*) were shown in Table 3. The results indicated that the soaking of Kordala seeds not affected the tannins concentration (0.02mg/100g), while phytic acid and polyphenols contents were decreased during soaking, phytic acid (from 743.5 to 588.9 mg/100g), polyphenols (from170.8 to 160 mg/100g) for raw and soaked seeds, respectively . These results in agreement with Shalini and Sudesh (2003) who reported that soaking of Fenugreek (*Trigonella foenum graecum L*) decreased phytic acid contents from 588.2 to 535.1mg/100g and polyphenols from 148.26 to 130.15mg/100g in raw and soaked seeds, respectively. Aarti *et al.* (2002) also reported that phytic acid contents decreased according to the periods of soaking from 6 days to 28%.

Changes in Amino acids of Kordala *(Maerua pseudopetalosa*) seeds due to the soaking process are shown in Table (4). The results indicated that the soaking process significantly decreased amino acids concentration these results relatively compatible with Mubarak (2005) who reported that the soaking of bean seeds (*Phaseolus aureus*) seeds decreased most of essential amino acids.

5. CONCLUSIONS

It may be inferred from the present study, soaking reduced bitterness and effected in the chemical composition, anti-nutritional factors of Kordala *(Maerua pseudopetalosa)* seeds. Soaking processes caused greater losses in minerals, protein and amino acids but improved the protein digestibility and decreased anti- nutritional factors.

Table-1. Proximate composition and *in vitro* protein digestibility of raw and soaked seeds of **Kordala *(Maerua pseudopetalosa***)
(Expressed as (%) on dry weight basis (DW)

	Raw seeds	**Soaked seeds**
Moisture	8.3 ± 0.05 **	9.62 ± 0.18 **
Crude protein	21.67 ± 0.27 **	11.64 ±0.11 **
Crude fiber	1.36 ± 0.18 **	4.27 ± 0.25 **
Fat	1.78± 0.19**	1.05 ± 0.04 **
Ash	2.9±0.3 **	0.3 ± 0.18 **
Total carbohydrate	63.99 ±0.28 **	73.12 ± 0.06 **
Protein digestibility	58.4±1.4**	68.1± 0.4**

Results are the mean ± SD of three determinations

** = high significant difference

Table-2. Concentration minerals of raw and soaked Kordala ***(Maerua pseudopetalosa***) seeds (Expressed as mg\ 100g) on dry weight basis

Elements	**raw seeds**	**Soaked seeds**
Na	5.66 ± 0.06 **	4.65 ± 0.09 **
K	250.8 ±10.91 **	23.4 ± 0.71 **
Ca	0.66 ± 0.027 *	0.47 ± 0.007 *
Mg	16.6 ± 0.117 **	9.31 ± 0.09 **
Mn	0.09 ± 0.0005 *	0.08 ± 0. 00 *
Fe	2.54 ± 0.07 **	0.09 ± 0.003 **
Cu	0.28 ± 0.02 *	0.21 ± 0.02 *
Zn	2.08 ±0.015 **	1.42 ± 0.035 **
P	3.05 ± 0.035 **	2.05 ± 0.017 **

- Results are the mean ± SD of three determinations

** = high significant difference * = significant difference

Table-3. Concentration anti-nutrition factors (mg/100 g) of raw and soaked **Kordala** ***(Maerua pseudopetalosa)*** seeds.

Anti-nutrition factor	raw seeds	Soaked seeds
Tannins	0.02 ± 00 ^{ns}	0.02 ± 00 ^{ns}
Polyphenols	170.8 ± 1.5 *	160 ± 1.5 *
Phytic acid	743.5 ± 10.6 **	588.9 ± 10.9 **

- Results are the mean ± SD of three determinations

** = high significant difference * = significant difference ^{nsd} = no significant difference

Table-4. Essential and non-essential amino acids composition (mg/100g DW) of acid hydrolysate of raw and soaked **Kordala (*Maerua pseudopetalosa*)** seeds:

Amino acid	Raw seeds	Soaked seeds	Human requirement***
Aspartic acid	750.53 ± 0.91 **	289.72 ± 2.33 **	
Thereonine	66.21 ± 0.13 **	47.87 ± 1.33 **	0.9
Serine	63.00 ± 0.25 **	49.93 ± 1.78 **	
Glutamic acid	214.51 ± 0.74 **	136.62 ± 1.15 **	
Glycine	24.00 ± 0.20 **	12.63 ± 0.63 **	
Alanine	513.69 ± 0.11 **	335.09 ± 0.01 **	
Cystine	44.04 ± 1.00 *	42.99 ± 0.05 *	
Valine	347.82 ± 1.28 **	255.86 ± 1.09 **	1.3
Methionine	16.86 ± 0.30 **	11.85 ± 0.62 **	2.2
Isoleucine	330.80 ± 0.33 **	244.96 ± 2.93 **	4.2
Leucine	281.97± 0.08 **	140.54 ± 0.66 **	1.9
Tyrosine	89.84 ± 0.40 **	26.82± 0.37 **	2.8
Phenylalanine	242.92 ± 1.54 **	192.55 ± 1.34 **	2.8
Histidine	23.54 ± 0.69 **	14.36 ± 0.54 **	1.6
Lysine	76.08 ± 1.49 **	32.13 ± 0.27 **	1.6
Arginine	392.27 ± 2.35 **	302.41 ± 3.68 **	
Proline	532.02 ± 0.30 **	427.21 ± 5.40 **	

- Results are the mean ± SD of three determinations; ***, FAO/WHO/UNU (1981).

** = high significant difference * = significant difference

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