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DETERMINATION OF NUTRITIVE VALUES OF GARDEN CRESS (*LEPIDIUM SATIVUM* L.) LEAVES

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ABSTRACT
The focus of this study was to investigate the nutritional values of Lepidium sativum leaves, a vegetable commonly consumed by the people of North-Western Nigeria. Sample of L. sativum leaves were collected from different farm lands at More town, Kware Local Government Area of Sokoto State. The leaves were dried then subjected to proximate, amino acids, minerals and antinutritional analyses. The results of proximate analysis indicate that the leaves had high crude protein (18.25%), crude fibre (9.31%) and ash (15.38%). The minerals assay showed that the leaves are particularly high in potassium (1850.00 mg/100g), calcium (829.13 mg/100g), magnesium (160.60 mg/100g), sodium (141.13 mg/100g) and iron (63.47 mg/100g) with low level of phosphorus (4.10 mg/100g), manganese (5.74 mg/100g), copper (0.39 mg/100g) and chromium (0.36 mg/100g). The amino acid profile revealed that the leaf protein is generally low in lysine, sulphur containing amino acids (methionine and cystein), and threonine. Lysine was the most limiting amino acid in the leaves. In terms of antinutritional factors, the leaves had low concentrations of phytate (10.95 mg/100g), nitrate (0.05 mg/100g) and HCN (31.54mg/100g) with moderate amount of oxalate (337.50 mg/100g). Based on these nutrient contents, the leafy vegetable will have potential benefits as part of feeding programmes, as well as their promotion as part of composite die.

Key words: Lepidium sativum, proximate analysis, amino acid, minerals, and antinutrients.

INTRODUCTION

Lepidium sativum L. (Plate 1) is a fast growing edible herb that belongs to the family Brassiacea (Cruciferae). It is commonly called garden cress, common cress, land cress etc. It is cultivated in India, North America and parts of Europe (Nuez and Hernandez-Bermejo, 1994). This annual plant can reach a height of 60cm, with many branches on the upper part. The white to pink flowers are 2 mm across, clustered in branched racemes. The plant is used as vegetable in Europe and America, the seeds are harvested for food purpose in several parts of India (Gokavi *et al*., 2004). The seeds were claimed to have various medicinal properties such as diuretic, tonic, aphrodisiac etc. The seeds are also used in the treatment of hiccup, dysentery, diarrhoea and diseases caused by impurities and toxins in blood. The seeds are also used by Ayurveda people to prevent postnatal haemorrhage (Gokavi *et al*., 2004).

In Nigeria, particularly North-Western part, there is an increase in the use of this plant as food in raw form like lettuce and cabbage or parboiled similar to spinach.Despite the use of the plant as food in this region, its nutritive value was not known to most consumers.

Plate 1: *Lepidium sativum* L

This study was conducted to investigate the nutritional composition of *L. sativum* leaves for their proximate composition, mineral contents, amino acids, antinutruents composition as a bases of fusing this plant as a source of food to humans.

MATERIALS AND METHODS

Sample Collection: Fresh leaves of *Lepidium sativum* were collected randomly along the beds of river Sokoto from different farm lands at More town, Kware Local Government Area of Sokoto State. The sample was identified and authenticated at Botany Unit, Department of Biological Sciences, Usmanu Danfodiyo University, Sokoto Nigeria.

Sample Treatment: The leaves of *Lepidium sativum* were thoroughly washed with distilled water, oven dried, pulverized using mortar and pestle, and the powdered sample stored in airtight containers. The powdered sample was used for the analysis except for moisture content in which fresh leaves were used.

Analytical Procedures

Proximate analysis

Moisture, ash, crude protein, crude lipid, dietary fibre and available carbohydrate (by difference) analyses were done using the methods described in AOAC (1990). Energy content was estimated in kcal/100g by the Atwater general factors system by multiplying the percentages of available carbohydrate, crude protein and crude lipid by 4, 4, and 9 respectively (Hassan and Umar, 2004).

Amino acids

Amino acids in acid hydrolysed sample were determined by ion-exchange techniques according to the method described by Adeyeye and Afolabi (2004).

Mineral analysis

Mineral analysis was carried out after sample digestion of 1g of the dried sample with 12 cm^3 mixture of nitric/perchloric/sulphuric acids in the ratio of 9:2:1 respectively (Sahrawa *et al*., 2002). The calcium (Ca), magnesium (Mg), iron (Fe), chromium (Cr), copper (Cu) and zinc (Zn) content was determined by atomic absorption spectrophotometry (AOAC, 1990). The potassium (K) and sodium (Na) content of the samples was determined through the flame photometric method (AOAC, 1990). The total phosphorus (P) content was determined by the molybdenum blue colorimetric method (James, 1995).

Antinutritional Analysis

Determination of phytate was done according to the procedure described by Ola and Oboh (2000), Total and soluble oxalate was determined using the methods of Krishna and Ranjhan (1980). Hydrocyanic acid was determined according to AOAC (1990) method. Nitrate was quantified according to IITA (1988) method.

RESULTS AND DISCUSSION

Proximate analysis

The results of proximate analysis of *L. sativum* leaves are presented in Table 1. From the results, the leaves had high moisture content (91.05±1.41%) which is within the range of 58.0±0.95% - 93.4±0.7% reported in some green leafy vegetables consumed in Sokoto, Nigeria (Ladan *et al*., 1996). Leafy vegetables are well known for their mineral content. The leafy vegetable analysed is not exceptional considering its high ash content (~15%), which is within the range of 9 -28% reported in some Nigerian green leafy vegetables (Ifon and Bassir, 1980; Ladan *et al.,* 1996). The leaves also have high amount of crude protein (18.25%). comparable values were also reported in some wild leafy vegetables such as *Momordica balsamina* (11.29 ± 0.07%), *M. oleifera* (20.72%), *Lesianthera africana* (13.10 – 14.90%) and *Leptadenia hastata* (19.10%) (Isong and Idiong, 1997; Sena *et al*., 1998; Lockett *et al.,* 2000; Hassan and Umar, 2006). The crude lipid content of *L. sativum* leaves (1.72 %) was low which is in agreement with the general observation that leafy vegetables are low lipid containing food, thus advantageous to people with obesity (Lintas, 1992). Available carbohydrate and energy value are high compared to respective values of 11.29±0.07 (%DW), 39.05±2.01 (%DW) and 189.22 (Kcal/100g) reported in *M. balsamina* leaves (Hassan and Umar, 2006).

Table 1: Proximate composition of *L. sativum* leaves

Parameter	Concentration (g/100g DW)
Moisture content	91.05±1.41
Ash	15.38±0.21
Crude Protein	18.25±0.1
Crude Lipid	1.72±0.18
Crude Fibre	9.31±0.13
Available Carbohydrate	55.34±0.20
Calorific value (kcal/100g)	312.20

Values represent means ± standard error of mean of triplicate reading.

Minerals

From the results presented in Table 2, it is apparent that *L. sativum* leaves could be regarded as important source of essential macroelements (K, Na, Ca, Mg) and trace minerals (Fe, Zn, Mn). Potassium is the most abundant mineral in the leaves (1850.00±43.30mg/100gDW). High amount of potassium was also reported in other leafy vegetables such as *Chenopodium album* (1326.9±118.2mg/100g FW), *C. opulifolium* (1443.5±123.8mg/100gFW) (Guil and Isasa, 1997) and *Cassia occidentalis* (2250mg/100gDW) (Hassan *et al*., 2002).

Potassium helps in maintaining normal physiological function of the body, normal water balance in the body and in balancing the pH of the body (Tazoe *et al*., 2007; O'shaughnessy, 2006). Sodium helps in regulating blood pressure and in maintaining proper function of muscle and nerves (Hassan and Umar, 2004). The concentration of sodium in *L. sativum* leaves, 141.13±38.19 mg/100g (DW) was low compared to 453.0±38.1mg/100g (FM) in *C. murale* leaves (Guil and Isasa, 1997).

The phosphorous content of *L. sativum* leaves was low compared to range of values 166 – 640mg/100g reported in some leafy vegetables consumed in Sokoto (Ladan *et al*., 1996). A high value (130.46mg/100g DW) was reported in *M. balsamina* leaves (Hassan and Umar, 2006). Magnesium is involves in calcium metabolism in bones and helps to prevent heart diseases (Hassan and Umar, 2006). *L. sativum* leaves have significant amount of this element (160.60±6.56 mg/100g DW). High level of magnesium was also reported in *M. oleifera* leaves (831mg/100g) by Lockett *et al*. (2000). The Ca content of *L. sativum* leaves was also higher than values reported in some leafy vegetables (Guil and Isasa,1997) even though Odhav *et al.* (2007) reported high amount of calcium in some other leafy vegetables such as *Amaranthus dubius* (1,686 mg/100g (DW) and *Amaranthus spinosus* (3931mg/100g (DW).

Iron is essential in the formation of haemoglobin and oxidation of carbohydrates, protein and fats (Adeyeye and Otokiti, 1999). The iron content of *L. sativum* leaves (63.47±5.27 mg/100g DW) was similar to 60.3mg/100g (DW) reported in *M. balsamina* leaves by Hassan and Umar (2006). This is indication that the leaves are rich source of dietary iron. Zinc is essential micronutrient involves in protein synthesis, DNA synthesis, wound healing and in cell division (Prasad, 1995; Heyneman, 1996). The zinc concentration of *L. sativum* leaves even though low, could supplement other dietary sources of this microelement. Copper facilitates iron uptake, thus helps in preventing cases of aneamia (NRC, 1989). The copper concentration of *L. sativum* leaves (2.28mg/100g (DW) was low compared to 3mg/100g (DW) in *Amaranthus dubius* (Odhav *et al*., 2007) and 5.44mg/100g (DW) in *M. balsamina* leaves (Hassan and Umar, 2006).

Manganese concentration of *L. sativum* leaves 5.74±0.11mg/100g (DW), was lower than 11.28mg/100g and 11.30mg/100g reported in *M. oleifera* and *Veronica colorate* leaves respectively (Lockett *et al*., 2000). Manganese acts as cofactor for some enzyme such as some oxidoreductases, transferases , hydrolases etc. Chromium (Cr^{3+}) enhances insulin action (Mertz, 1993, 1998). The chromium concentration of *L. sativum* leaves 0.36±0.27mg/100g (DW).

Table 2: Mineral composition of *L. sativum* leaves

Element	Concentration (mg/100g DW)
Potassium	1850.00±43.30
Sodium	141.13±38.19
Calcium	829.13±20.70
Magnesium	160.60±6.56
Phosphorus	4.10±0.44
Iron	63.47±5.27
Zinc	2.28±0.07
Copper	0.39±0.02
Manganese	5.74±0.11
Chromium	0.36±0.27

Values represent means ± standard deviation of mean of triplicate reading.

Amino acids

The amino acids content in the *L. sativum* leaves studied is summarized in Table 3. Glutamic acid, aspartic acid and leucine were the most abundant amino acids. Similar trend was reported in mushroom (Ayaz *et al*., 2011) and some wild leafy vegetables (Hassan and Umar, 2008). The total essential and non-essential amino acid contents were 25.9 g/100g protein DW and 74.1 g/100g protein DW respectively, and they accounted for 41.5% and 58.5% of the total amino acid content, respectively.

Among the essential amino acids, leucine was the most abundant (6.84 g/100g protein DW). The second most abundant essential amino acid was phenylalanine (4.77g/100g protein DW). To asses the protein quality of plant material used as food, its amino acids content are compared with the standard amino acid profile established for both adults and preschool children by (FAO/WHO/UNU, 1991). The result as shown in Table 3, *L. sativum* leaves are deficient in sulphur containing amino acids (methionine and cystein), lysine and threonine (Table 3). It has been reported that certain essential amino acids such as lysine are often insufficient in many vegetable foods (Wallace *et al*., 1998; Ayaz *et al*., 2011). Nevertheless, the leafy vegetable analysed is rich in other essential amino acids namely; isoleucine, leucine, aromatic amino acids (phenylalanine + tyrosine) and valine. Thus, there is a need for consuming the plant with other food materials that can provide the limiting amino acids.

Table 3: Amino acid composition of *L. sativum* leaves compared with reference standard

Parameter	Concentration (g/100g protein DW)	Protein Score (%)	FAO/WHO/UNU Reference guide
Isoleucine (Ile)*	3.26± 1.05	116	2.8
Leucine (Leu)*	6.84±1.02	104	6.6
Lysine (Lys)*	3.5±0.21	60	5.8
Methionine (Met)*	1.11±0.1	61[§]	2.5
Cystein (Cys)	0.42±0.21		
Phenylalanine (Phe)*	4.77±2.02	117[‡]	6.3
Tyrosine (Tyr)	2.59±1.20		
Threonine (Thr)*	2.61±1.04	77	3.4
Valine (Val)*	3.85±0.25	110	3.5
Alanine (Ala)	4.31±0.90		
Arginine (Arg)	4.32±1.78		
Aspartic acid (Asp)	7.73±2.77		
Glutamic acid (Glu)	9.36±0.06		
Glysine (Gly)	1.24±0.24		
Histidine (His)	2.09±1.00		
Proline (Pro)	2.16±0.16		
Serine (Ser)	2.31±0.01		

Values represent means ± standard deviation of mean of triplicate reading.
*Essential amino acids, [§] Sum of sulphur containing amino acids (Met + Cys)
[‡] Sum of aromatic amino acids (Phe + Tyr)

Antinutritional composition

Table 4 shows the result of the antinutritional composition of *L. sativum* leaves. The sample phytate level (10.95±2.66mg/100g DW) is lower than 22.25±0.02 mg/100g and 21.45±0.06 mg/100g reported in *P .mildbreadii* and *T. triangulera* respectively (Nwachukwu and Obi, 2007). High dietary phytate content is reported to cause growth reduction (Redek and Savage, 2008), affect food value by binding and making mineral ions unavailable to the consumer, affect the homeostasis of Zn and Fe, inhibit enzymatic digestion of proteins by forming complexes with enzyme proteins and cause rickets in young dogs (Wallace *et al*., 1998). Nevertheless, phytate was reported to be anti-carcinogen and a potent antioxidant (Hassan and Ngaski, 2007).

The oxalate level in *L. sativum* leaves 337.50±56.25 mg/100g (DW) was low compared to 12,576.2±590.85mg/100g for Spinach and 10,056.3±26.2mg/100g Green amaranthus (Redek and Savage, 2008). Oxalic acid combine with divalent cation such as Ca^{2+}, Fe^{2+} and Mg^{2+} to form crystals of corresponding oxalates, which irritate the gut and kidney (Umar ,2005 ; Hossain *et al*., 2006). The level of oxalate in the *L. sativum* leaves analysed is below the humans toxic level of 2 – 5 g (Hassan and Umar, 2004).

The HCN concentration of *L. sativum* leaves is 31.54±1.94 mg/100g (DW). Even though the amount was higher than 0.132mg/100g (DM) in *Cassia siamea* leaves (Hassan and Ngaski, 2007) and 0.15±0.03mg/100g in *Afrofritonia sylvestris* (Iwuoha *et al.,* 2002), the level is within the permissible range for human consumption. Only plants with more than 200 mg of HCN equivalent per 100 mg fresh weight are considered dangerous (Betancur-Ancona *et al*., 2008). The nitrate level of *L. sativum* leaves 0.05±0.01 mg/100g (DW) was low compared to tolerance level of 220mg/day for a 60kg person (Umar, 2005).

Table 4: Antinutritional composition of *L. sativum* leaves

Parameter	Concentration (mg/100gDW)
Phytate	10.95±2.66
Oxalate	337.50±56.25
HCN	31.54±1.94
Nitrate	0.05±0.01

Data are mean ± standard deviation of triplicate determinations

CONCLUSION

In conclusion, *L. sativum* leaves have moderate concentrations of ash, crude protein, crude fibre and low energy value as indicated from the study. The results also indicate the leafy vegetable is rich in essential amino acids namely; isoleucine, leucine, aromatic amino acids and valine but deficient in sulphur containing amino acids, lysine and threonine. High level of dietary minerals was also recorded. In addition, the result also indicates low level of antinutrients. Thus, the plant could be used as source of food since processing methods such as cooking and boiling reduce the levels of antinutrients such as oxalate and phytate.

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