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Determination of Nutrients and Anti-Nutrients Contents of *Moringa oleifera* and *Arachis hypogaea*

Alhassan Ahmad Siddan[1]*, Salisu Maiwada Abubakar[2, 3], Aisha Muhammad Gadanya[2], Fatima Umar Maigari[1], AbdulRazaq Sani Yahaya[2], Mariya Yarima[4]

[1]Department of Biochemistry, Faculty of Science, Gombe State University Gombe, P.M.B 127 Gombe- Nigeria.
[2]Department of Biochemistry, Bayero University Kano, PMB 3011, Kano – Nigeria.
[3]Africa Centre of Excellence in Population Health and Policy, Bayero University Kano, P.M. B. 3011, Kano – Nigeria.
[4]Kano State Senior Secondary Schools Management Board, Kano Municipal Zone, Kano-Nigeria.

*Corresponding author:
Alhassan Ahmad Siddan,
Department of Biochemistry,
Faculty of Science,
Gombe State University, P.M.B. 127,
Tudun wada Gombe, Gombe, State, Nigeria.
Phone Number: +2348032050616, +2348083880890
Email: alhassanahmadsiddan@gmail.com

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ABSTRACT

Proximate, minerals, vitamins, amino acids composition and phytochemicals of *Moringa oleifera* and *Arachis hypogaea* were investigated. The parameters evaluated were moisture contents; ash contents; crude protein; crude lipids; crude fiber; carbohydrates; mineral ions; vitamins; amino acids and phytochemicals. The results obtained showed that, all the proximate parameters, vitamins; A, C and E, all the phytochemical parameters and minerals; sodium and potassium are significantly different ($p<0.05$) while no significant different at $p<0.05$ was found in the amount of magnesium, potassium, iron, calcium and copper in *M. oleifera* and *A. hypogaea*. High caloric value was found in *A. hypogaea* while high amount of vitamin A and C were found in *M. oleifera.* Also, phytochemicals such as flavonoids and steroids were found in *A. hypogaea* at high amount. Eighteen amino acids were detected in both the *M. oleifera* and *A. hypogaea*. Glutamic acid, aspartic acid, leucine, arginine, valine, proline were present at high concentration in both the two samples.

INTRODUCTION

Moringa oleifera is plants which belong to the family of moringaceae and is a helpful remedy for malnutrition. It is sometimes called a miracle plants due to its numerous important in terms of nutrition and medicine. *M. oleifera* is most widely cultivated because of its adverse uses and vital nutrients. Almost all the parts of the tree are very useful [1]. It is an important tree in which the leaves have been reported to contain substantial amounts of vitamins, proteins, fiber and minerals [2] and also a good source of phytonutrients like carotenoids, tocopherols ascorbate [4,5]. It also consists of minerals such as calcium, potassium, zinc, magnesium, iron, and copper [5]. Vitamins such as beta-carotene of vitamin A, vitamin B like folate, nicotinic acid, and pyridoxine, vitamin C, D, and E are also present [6].

Phytochemicals such as tannins, sterols, terpenoids, flavonoids, saponins, anthraquinones, alkaloids and reducing sugars are also present [7]. Research shows that immature pods contain around 46.78% fiber and around 20.60% protein content. Pods have 30% of amino acid content; leaves have 44% and flower have 31% [8]. Groundnut (*Arachis hypogaea* L.) is a plant of the Fabaceae family, which is the second most important leguminous crop in the world after soybean that contains essential foods for human and livestock consumption and has a component of dietary protein in the absence of meat. The nut has a high nutritive value which is affordable and can be used in a variety of ways such as con factory products and in supplementary feeding programs such as in weaning food formulation in combination with other cereals and pulses in many developing countries.

There is a preparation of food that involves groundnut to improve the level of protein has helped in several ways to reduced malnutrition in many developing countries [9]. Nutritionally, the seeds of groundnut provide an extensive source of high quality of dietary protein, oil, niacin, fiber and rich in sources of minerals such as phosphorus, calcium, magnesium, potassium and manganese, and vitamins (E, K and B complexes) [10]. The seeds of groundnut are reported to contain 44-56% oil and 22-30% protein on a dry seed basis and also contain 9.5-19.0% total carbohydrates as both soluble and insoluble carbohydrates [11, 12, 13, 14, and 15]. They are also naturally free from trans fatty acids and sodium [10].

MATERIALS AND METHODS

Materials
The chemicals used throughout this work were of analytical grade and purity. The major equipment used was Atomic absorption spectrophotometer, Flame Photometer, Amino acid analyzer.

Samples collection and Identification
Moringa leaves, Groundnut seeds were obtained from Rimi main market, Kano State and carefully selected and labeled properly in polythene bags. The samples were taken to the botany unit of Bayero University Kano and identified as: *Moringa oleifera* (Zogale in Hausa) with BUK Herbarium Accession Number: BUKHAN 0011, and *Arachis hypogaea* (Gyada in Hausa) with BUK Herbarium Accession Number: BUKHAN 0405.

Proximate Composition
Proximate analysis was carried out according to the methods of the Association of Official Analytical Chemist [16].

Mineral Analysis
Mineral elements were extracted from the samples by wet digestion as described by AOAC, 1990. From the filtrate of the digested samples, Magnesium (Mg), Iron (Fe) and Copper (Fe) were determined using Atomic Absorption Spectrophotometer (BUCK Scientific 205 USA) while Sodium (Na), Potassium (K) and (Ca) were determined using Flame Photometer PFPT (JENWAY UK Model 8515)

Vitamins Analysis
The vitamin A (Retinol), Vitamin C (Ascorbic acid) and Vitamin E (Tocopherol) in the samples were determined by the official methods of the Association of Official Analytical Chemists [16].

Amino acid Analysis
The Amino Acid profile in the known sample was determined using methods described by Benitez [17]. The known sample was dried to constant weight, defatted, hydrolyzed, evaporated in a rotary evaporator and loaded into the Applied Biosystems PTH Amino Acid Analyzer.

Quantitative Phytochemical screening
An analytical method for the quantitative determination of tannin was according to Amadi *et al.* [18]; Ejikeme *et al.* [19]. The determination of alkaloids was according to Harborne, [20]. Flavonoid determination was by the method reported by Ejikeme *et al.* [19]; Boham and Kocipai, [21]. Saponin quantitative determination was carried out using the method reported by Ejikeme *et al.* [19]; Obadoni and Ochuko, [22].

The determination of Oxalate was carried out using the method reported by Ejikeme *et al.* [19] and Munro and Bassir, [23]. Glycoside's quantitative determination of methodology used in this research is that by Amadi *et al.* [18] as reported by Ejikeme *et al.* [19].

Statistical Analysis
Each experimental analysis was done in triplicate. Data obtained from experiments were analyzed by U-ANOVA (Univariate Analysis of Variance) using GraphPad INSTAT statistics software. Significance was accepted at 0.05 level of probability ($p < 0.05$). The analysis was used to compare the proximate, elemental composition, vitamins, phytochemicals of the two samples

RESULTS
The results of the proximate compositions of *Moringa oleifera* and *Arachis hypogaea* is presented in **Table 1**. The results revealed that *M. oleifera* has high amount of moisture, ash, protein and carbohydrate while *A. hypogaea* has highest amount of fat and caloric value. The results of the mineral elements and Vitamins contents of *Moringa oleifera* and *Arachis hypogaea* are presented in **Table 2**. The results showed that both the *M. oleifera* and *A. hypogaea* contain a relatively high amount of sodium, magnesium and potassium and a minute amount of calcium, iron and copper, and a significant amount of vitamin A, C and E. The results of amino acids compositions of *Moringa oleifera* and *Arachis hypogaea* is presented in **Table 3**.

The results revealed both the two samples contained all the essential and non-essential amino acids, some at low concentrations while some at higher concentrations. The results of the phytochemical constituents of *Moringa oleifera* and *Arachis hypogaea* is presented in **Table 4**. The results showed that alkaloids, phytate, oxalates were present at high concentration in *M. oleifera* while flavonoids, steroids and tannins were present at high concentration in *A. hypogaea.*

Table 1. Proximate Compositions of Moringa oleifera and *Arachis hypogaea.*

Contents	*Moringa oleifera*	*Arachis hypogaea*
Moisture (%)	8.94 ± 0.08^{a}	4.81 ± 0.09^{b}
Ash (%)	9.04 ± 0.08^{a}	1.57 ± 0.24^{b}
Crude Fibre (%)	9.14 ± 0.08^{a}	2.50 ± 0.20^{b}
Crude Fat (%)	2.11 ± 0.18^{a}	37.80 ± 0.40^{b}
Protein (%)	23.88 ± 0.18^{a}	21.10 ± 0.07^{b}
Carbohydrates (%)	46.75 ± 0.20^{a}	32.21 ± 0.50^{b}
Energy (Kcal/g)	301.51 ± 0.36	610.24 ± 0.67

All data expressed in triplicate as mean ± SEM, values with a different superscript in the same row are significantly different at $p<0.05$

Table 2. Minerals and Vitamins contents (mg/100g) of Moringa oleifera and *Arachis hypogaea.*

Contents	*Moringa oleifera*	*Arachis hypogaea*
Sodium	8.60 ± 0.37^{c}	6.58 ± 0.45^{d}
Magnesium	3.99 ± 0.22^{c}	2.49 ± 0.05^{d}
Potassium	6.56 ± 0.28^{c}	5.74 ± 0.38^{c}
Iron	0.75 ± 0.21^{c}	0.96 ± 0.14^{c}
Calcium	0.64 ± 0.14^{c}	0.47 ± 0.13^{c}
Copper	0.30 ± 0.03^{c}	0.72 ± 0.15^{c}
Vitamin A	73.21 ± 0.38^{c}	11.01 ± 0.09^{d}
Vitamin C	52.82 ± 0.19^{c}	16.05 ± 0.65^{d}
Vitamin E	16.94 ± 0.18^{c}	15.00 ± 0.09^{d}

All data expressed in triplicate as mean ± SEM, ND=Not detected, values with a different superscript in the same row are significantly different at $p<0.05$

Table 3. Amino acid compositions (mg/100g protein) of *Moringa oleifera* and *Arachis hypogaea.*

	(Concentration mg/100g)	
Amino acids	*Moringa oleifera*	*Arachis hypogaea*
Leucine*	8.64	6.48
Lycine*	4.35	3.39
Isoleucine*	3.93	3.54
Phenylalanine*	4.61	4.43
Tryptophan*	0.95	1.21
Valine*	4.34	4.33
Methionine*	1.17	1.76
Proline	3.05	3.45
Arginine	4.82	8.77
Tyrosine	3.10	2.41
Histidine*	2.36	2.36
Cysteine	0.97	1.33
Alanine	4.25	3.34
Glutamic acid	11.05	15.29
Glycine	3.94	3.52
Threonine*	3.11	3.66
Serine	2.86	3.62
Aspartic acid	9.06	9.68

*Essential Amino acids

Table 4. Phytochemical contents (mg/100g) of Moringa oleifera and *Arachis hypogaea*.

Parameters	*Moringa oleifera*	*Arachis hypogaea*
Saponins	2.52 ± 0.54^{ef}	11.42 ± 0.21^{gh}
Tannins	9.67 ± 1.02^{ef}	0.21 ± 0.02^{gh}
Glycosides	0.53 ± 0.08^{ef}	10.56 ± 0.38^{gh}
Alkaloids	20.53 ± 0.15^{ef}	0.32 ± 0.24^{gh}
Steroids	5.66 ± 0.24^{ef}	20.86 ± 0.12^{gh}
Flavonoids	7.33 ± 0.54^{ef}	31.64 ± 0.58^{gh}
Oxalates	9.84 ± 0.06^{ef}	2.87 ± 0.03^{gh}
Phytate	14.30 ± 0.13^{ef}	1.78 ± 0.02^{gh}

All data expressed in triplicate as mean ± SEM, ND=Not detected, values with a different superscript in the same row are significantly different at $p<0.05$

DISCUSSIONS

The percentage of moisture content in *M. oleifera* and *A. hypogaea* were found to differ significantly at ($p<0.05$). These values are in the same range with values reported by Okiki *et al.* [24] for *M. oleifera* and Kumar *et al.* [25] for *A. hypogaea.* Moisture enhances storage stability by preventing mold growth and also suitability and adaptability for further use in food formulation. A significant difference ($p<0.05$) was found in the percentage of ash in *M. oleifera* and *A. hypogaea*. Okiki *et al.* [24] reported similar value for *M. oleifera* while Atasie *et al.* [26] reported higher value for *A. hypogaea* than the present study. The higher ash content in *M. oleifera* indicates that it is rich in mineral elements. Also, a significant difference ($p<0.05$) was found in the amount of crude fibre *Moringa oleifera* and *A. hypogaea*. Eshun *et al.* [27] reported a value for *A. hypogaea* similar to the present study. A high amount of fiber in *M. oleifera* is of advantage and hence may have potential uses as a food supplement. The amount of lipid in *M. oleifera* and *A. hypogaea* differ significantly ($p<0.05$). Okiki *et al.* [24] reported a value in close agreement with present study for *M. oleifera*, while Kumar *et al.* [25] reported a similar value for *A. hypogaea.*

The fat content is important in diets as it promotes fat-soluble vitamins absorption. The amount of proteins in *M. oleifera* and *A. hypogaea* differ significantly at $p<0.05$. Okiki *et al.* [24] reported a similar value for *M. oleifera* while Kumar *et al.* [25] also reported a value in close agreement with present study for *A. hypogaea.* The high protein content is good for human consumption and as an important animal feed and contributes to the growth and repair of worn-out tissues. A significant difference ($p<0.05$) was found in the carbohydrate composition of *M. oleifera* and *A. hypogaea*. Generally, carbohydrates add to the bulk of the diets, they play a pivotal role as they provide energy to cells such as brain, muscles, and blood. There is also a significant difference ($p<0.05$) in the caloric value of *Arachis hypogaea* and *M. oleifera*.

The results of the mineral composition of *M. oleifera* and *A. hypogaea* were presented in table 2. The result revealed that the amount of sodium (mg/100g) in *M. oleifera* and *A. hypogaea* differ significantly at $p<0.05$. Sodium is an important source of electrolytes within the body. There is also a significant difference ($p<0.05$) in the amount of Magnesium in *M. oleifera* and *A. hypogaea.* Atasie *et al.* [26] reported a value for *A. hypogaea* similar to the present study. Magnesium is required in over 300 enzymes that use ATP and contribute to DNA and RNA synthesis during cell proliferation. The amount of Potassium (mg/100g) in *M. oleifera* and *A. hypogaea* showed no significant difference ($p<0.05$). Potassium is very important in the regulation of water, electrolyte and acid-base balance in the body as well as responsible for nerve and functioning of the muscles. The amount of Fe in the two samples showed no significant difference ($p<0.05$). Eshun *et al.* [27] reported a high amount of Fe for *A. hypogaea* than the present study. Iron plays a pivotal role in immune function, cognitive development, temperature regulation, and energy metabolism. There is also no significant difference ($p<0.05$) in the amount of calcium in the two samples. Eshun *et al.* [27] reported higher amount of calcium for *A. hypogaea* than the present study. Calcium is very essential in blood clotting, muscles contraction and certain enzymes in metabolic processes. The amount of copper in *M. oleifera* and *A. hypogaea* showed no significant difference ($p<0.05$). Copper accelerate wound healing by increasing blood flow to the affected area and movement of oxygen around the body.

The results of the vitamin analysis in the samples (table 2) showed that the amount of vitamin A (mg/100g) in *M. oleifera* and *A. hypogaea* differ significantly at $p<0.05$. Vitamin A plays an important role in bone growth, tooth development, reproduction, cell division, gene expression and regulation of the immune system. There is also a significant difference ($p<0.05$) in the amount of vitamin C in the samples. Vitamin C aids in wound healing, bone, and tooth formation, improving immune system function, increasing absorption and utilization of iron and acts as an antioxidant. The amounts of vitamin E in the samples showed no significant difference ($p<0.05$) in *M. oleifera* and *A. hypogaea.* Vitamin E benefits the body by acting as an antioxidant and protecting vitamins A and C, red blood cells and essential fatty acids from destruction.

The result of the amino acid composition showed that the *M. oleifera* and *A. hypogaea* contained both the essential and non-essential amino acids; some were at higher concentrations while some at lower concentrations. *M. oleifera* contained highest amounts of glutamic acid, aspartic acid, leucine, while *A. hypogaea* contained a high amount of glutamic acid, aspartic acid, leucine. Other amino acids like tryptophan, cysteines were present at low concentration in *M. oleifera.* The amino acid plays a central role both as building blocks of protein and as intermediates in metabolism. The result of the phytochemical analysis is presented in table 4. Phytochemicals possess many properties that makes them vital to both plants and animals. Their examination in the samples revealed that they are a rich source of phytochemicals. The amount of saponin in *A. hypogaea* and *M. oleifera* showed a significant difference ($p<0.05$). Saponins are effective in maintaining liver function, lowering blood cholesterol, preventing peptic ulcer, osteoporosis as well as platelet agglutination. There is also a significant difference ($p<0.05$) in the amount of tannins in the samples. Tannins have

shown potential antiviral, antibacterial and antiparasitic effects. It was also reported that certain tannins are able to inhibit HIV replication selectivity and is also used as diuretic. The amounts of glycosides in *A. hypogaea* and *M. oleifera* significantly differ at $p<0.05$. A significant difference ($p<0.05$) was found in the amount of alkaloids in *M. oleifera* and *A. hypogaea.* Alkaloids have antimicrobial properties due to their ability to intercalate with DNA of the microorganisms. There is also a significant difference ($p<0.05$) in the amount of steroids in *Arachis hypogaea* and *M. oleifera.* Steroids increase protein synthesis, promoting the growth of muscles and bones. A significant difference ($p<0.05$) was found in the amount of flavonoids in *A. hypogaea* and *M. oleifera*.

Flavonoids have protective effects including anti-inflammatory, anti-oxidant, anti-viral, and anti-carcinogenic properties. Preliminary research indicates that flavonoids may modify allergens, viruses, and carcinogens, and so may be biological "response modifiers". There is a significant difference ($p<0.05$) in the amount of oxalates in the two samples. Oxalate function as chelating agents and may chelate many toxic metals such as mercury and lead. A significant difference ($p<0.05$) was found in the amount of phytate in *M. oleifera* and *A. hypogaea*. Phytates are known to pose to leguminous seeds and also associated with increased cooking time in legumes.

CONCLUSION

In conclusion, *M. oleifera* leaves and *A. hypogaea* are multipurpose plants that could contribute immensely towards meeting the daily human nutritional requirement due to their significant amount of minerals, essential vitamins, proteins, lipids, essential and non-essential amino acids and a lot of phytochemicals required for proper functioning of the body system and when consumed in required amount may prevents or tackle the incidence severe acute malnutrition in children under five especially in Northern parts of Nigeria as they are available and affordable all over the country.

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CONFLICTS OF INTERESTS

The authors declared that there is no conflict of interest regarding the publication of this paper.

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