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The nutritional value of a local cultivar of *Moringa oleifera* leaves and its dietary evaluation in wistar albino rats

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ABSTRACT

The proximate analysis and some anti-nutritional factors of the leaves of *Moringa oleifera (*Lam) were determined using standard analytical methods. Proximate analyses and vitamin estimation were done using the methods of the Association of Analytical Chemists. The amino acid and mineral estimations were done using the Technicon sequential Multi-sample amino acid analyzer (TSM) and Atomic absorption spectrophotometer respectively. The leaves contained 20.00 ±4.00% fat, 27.60 ±0.20% protein, 33.93% carbohydrate, 11.60 ±6.32% ash, 6.87 ±0.86% moisture and 93.13 ±0.86% dry matter. The total energy value of the leaves was 426.12 kcal/100g. The amino acid determination showed that the leaves contained both the essential and non-essential amino acids. The *Moringa oleifera* leaves had higher amount of vitamin C (773.3mg/100g), and the lower levels of niacin (50.35mg/100g), pyridoxine (57.29mg/100g), riboflavin (14.82mg/100g), and thiamine (18.47mg/100g). It contained sodium (104.06mg/100g) and lower level of potassium (20.81mg/100g). The quantitative analysis showed that the leaves had higher amount of tannins (420mg/100g) and lower levels of cyanogenic glycosides (32.40mg/100g), saponins (11.8mg/100g), oxalates (7.3mg/100g) and phytates (0.66mg/100g). Growth rates for wistar albino rats fed with *M. oleifera* leaves increased significantly at 0.05 levels (from 46.73±3.81 to 66.59±5.27). The proximate analysis and animal feeding showed that the leaves of *Moringa oleifera* are nutritionally adequate for both humans and animals.

KEYWORDS

Moringa oleifera;
Proximate analysis;
Anti-nutritional factors.

INTRODUCTION

Moringa oleifera belongs to the family Moringaceae and is the best known specie, out of about fourteen species of *Moringa* known. It is native to sub-Himalayan parts of northern India, but now widely distributed in the tropics and sub-tropics[1-3] because it tolerates a wide range of soil and rainfall conditions. It is resistant to drought because of the presence of a long taproot.

In Nigeria, *Moringa oleifera* is called different vernacular names in the major ethnic groups vis-a-vis:

Ibo : okwe oyibo, okochi egbu, oku-ghara ite, 7odudu oyibo etc

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Yoruba : ewe ile, ewe igbale, idagbo monoye etc
Hausa : zogalla, zogalla-gandi, bagaruwar, maser etc
Fulani : gawara, rinimaka etc
English : Horse-raddish tree, radish tree, mother's best friend etc.

Sources[3,4,25]

The edible leaves are very nutritious and are consumed throughout West Africa including Nigeria as well as in some parts of Asia[5]. The leaves can be eaten fresh, cooked or stored as dried powder for months without loss of nutritional value[6]. *Moringa oleifera* has been used to combat malnutrition especially among infants and nursing mothers[1,3,7].

Moringa is therefore, a multi-purpose, miracle tree. Some of the uses include in alley cropping, animal forage, as domestic cleaning agent, as dye, as fertilizer, as gum, as honey clarifier, as honey producer, for live fencing, as medicine, as ornamental, for plant disease prevention, as pulp, for rope making and as tanning hides[1].

The nutritional properties of *Moringa oleifera* leaf are well known that there seems to be little doubt of the substantial health benefit to be realized by its consumption in situations where starvation is imminent. Studies on the dietary constituents of the leaves credit it with essential amino acids, which is important in bridging the protein gap of poor countries like Nigeria. Empirical data is required to sufficiently support this. Literature suggests that most studies so far conducted on *Moringa* were conducted overseas outside the shore of Nigeria. There is paucity of information on the biochemistry and phytochemistry of *Moringa* trees cultivated in Nigeria. Since soil and physiographic factors have been shown to affect plant constituents, a study of this nature is desirous.

This work is therefore, aimed at documenting the nutritional value of the leaves of M*oringa oleifera* grown in Awka, *A*nambra state, Nigeria.

EXPERIMENTAL

Sample collection

The fresh leaves were collected from the gardens in Ifite, Awka, Anambra state, Nigeria. The leaves were air-dried at 30 °C (temperature) for one day and ground into fine powder using manual grinder. The milled samples were kept in screw-capped containers and stored in a deep freezer and used within seven days for analysis.

Proximate analysis, vitamin and mineral composition

The methods of the Association of Official Analytical Chemists[8] were used for the determination of moisture, crude protein, crude lipid, ash and dry matter. The determination of the water-soluble vitamins namely niacin, pyridoxine, riboflavin, and thiamine in the leaves were by high performance liquid chromatography (HPLC), as described by AOAC[8]. The mineral content was estimated using atomic absorption spectrophotometer (AAS).

Determination of amino acid profile

The amino acid content of *Moringa oleifera* leaves was determined using method described by Speckman *et al*[9]. The dried and milled sample was defatted, hydrolysed, evaporated in a rotary evaporator and then loaded into the Technicon sequential Multi-Sample Amino Acid Analyzer (TSM). The amino acid values of the sample were calculated from the chromatogram peaks

Estimation of energy value

The sample calorific value was estimated in kilocalories by multiplying the percentage crude proteins, crude lipid and carbohydrates by the recommended factors 4, 9, and 4 respectively[10].

Determination of the anti-nutrients

The levels of oxalates[11], phytates[12], tannins[13], saponins[13], and cyanogenic glycosides[13], were determined using the prescribed methods.

Dietary evaluation using wistar albino rats

Fifteen (15) Wistar albino rats (28-day old) were used for the experiment. They were divided into three groups, each group containing five rats of average weight. The first group (test) was fed with compounded diet containing the following: cornstarch (50.8%), oil (10.0%), vitamin & mineral mix (3.0%), and *Moringa* leaf (36.2%) while the remaining two groups (controls) were fed with commercially prepared rat pellets and casilan diet respectively. The casilan diet contained cornstarch (75.9%), oil (10.0%), vitamin and mineral mix (3.0%), and casilan (11.1%). The feeding trials were done at 10% protein level. The trials lasted for three weeks, after the initial

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one week acclimatization. The weights of the rats were measured every three days until the end of the feeding trials and the growth pattern determined.

RESULTS AND DISCUSSION

Figure 1 showed the proximate composition of *M. oleifera* leaves (Mean ± S.E.M). It contained %fat (20.00 ± 2.31). % crude proteins (27.60 ± 0.14), carbohydrates (33.93%), %ash (11.60 ± 3.65), and %moisture (6.87 ± 0.50). The energy value was 426.12 Kcal/100g. From the composition, the leaf is a good source of proteins (27.60 ± 0.14%), since according to Pearson[14], any plant food that provides more than 12% of its calorific value from protein is a good source of protein. This value agrees with the work of Fuglie[6], who reported that *Moringa oleifera* leaves contained 27.1% proteins. The leaf is also a good source of fats (20.00±2.31%) and carbohydrates (33.93%). The crude protein content of leaves of *Moringa oleifera* was 260 g kg^{-1}[15], which was similar to what we got in our studies. The protein content of the leaves compared favourably with that of *Piper guineeses*, 29.78%[16]. *Moringa oleifera* had been reported as a nutritional supplement, apart from its medicinal and water treatment applications. Already, in Senegal, Ghana, India and other parts of the world, *Moringa* leaves are used in treating malnutrition and promoting physical and mental well being with visibly effective results, particularly in children, pregnant and lactating mothers[1,6,7,17].

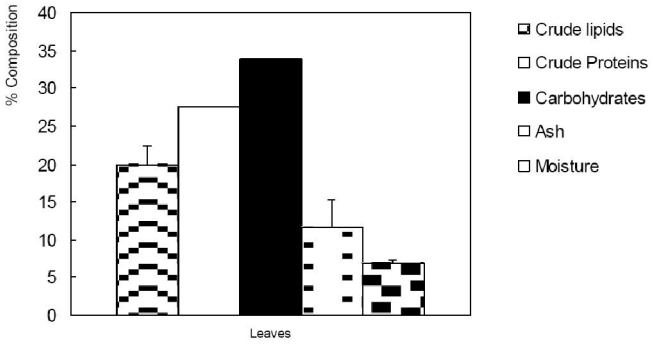

Figure 1 : The proximate composition of *Moringa oleifera* leaves (Mean ± S.E.M).

Figure 2 showed the amino acid content of the *M. oleifera* leaves. The essential amino acid that contained the highest amount was leucine (7.53mg/100g protein) and the least was methionine (1.35mg/100g protein). The plant leaves contained all the essential amino acids as reported by Fuglie[6]. However, the percentage of essential (EAA) and non-essential (NEAA) amino acids were almost equal unlike in many plants, where NEAA were always higher than the EAA[18]. The % of EAA in the leaves was 50.66% and NEAA was 49.33%. The most abundant EAA was leucine (7.53g/100g protein) while that of NEAA was glutamic acid (9.46g/100g protein). Similar observations were made by Adeyeye[19] and Akubugwo *et al*[18]. The proportion of aromatic amino acids indicated that it was lower than branched chain, acidic or basic amino acids in the leaves. In this study, seventeen (17) amino acids were found instead of the twenty (20) naturally occurring amino acids commonly found in proteins[18,20]. Glutamine and Asparagine which are merely amide derivatives were not detected because they were easily converted to their corresponding acids- glutamic and aspartic acids respectively[21]. Also, tryptophan was not detected because of its complete destruction during acid hydrolysis[22,18]. This might explain the higher levels of glutamic acid and aspartic acid in our results. The results showed that the amino acid contents of the leaves were higher than the values reported by Fuglie[6], for the dry leaf powder. However, this study confirmed the earlier reports by Fuglie[6], Oliveira *et al*[23] and Makkar and Becker[15] that *Moringa oleifera* contained all the essential amino acids needed for normal body functioning.

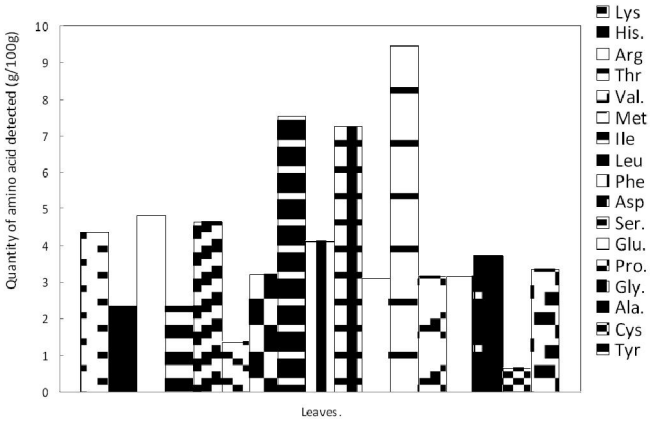

Figure 2 : The amino acid composition of *Moringa oleifera* leaves.

Figure 3 showed the mineral composition of *Moringa oleifera* leaves. The level of sodium was higher (104.06mg/100g), while those of calcium and potassium were lower, 13.45mg/100g and 20.81mg/

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100g respectively. Lead and Barium were not detected.

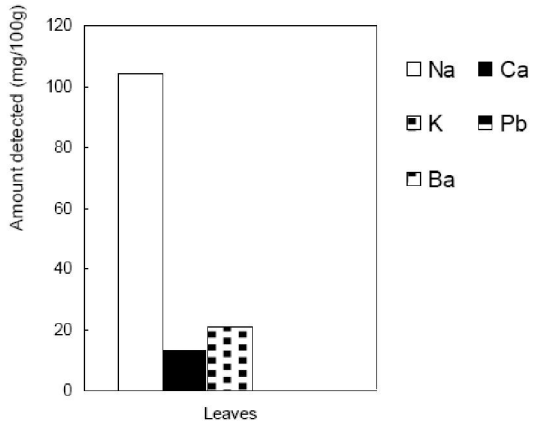

Figure 3 : The mineral composition of *Moringa oleifera* leaves.

The vitamin composition of the leaves are shown in Figure 4. All the water-soluble vitamins determined were detected, the highest being ascorbic acid (773.30mg/100g). Others were 18.47mg/100g, 14.82mg/100g, 57.29mg/100g and 50.35mg/100g for thiamine, riboflavin, pyridoxine and niacin respectively. Apart from riboflavin (14.82mg/100g), the values are higher than what were reported by Fuglie[6], Foild *et al*[24] and Ozumba[25]. Fuglie[6], reported that the leaves of *Moringa oleifera* contained thiamine (2.64mg), riboflavin (20.5mg), nicotineamide (8.2mg), and ascorbic acid (17.3mg).

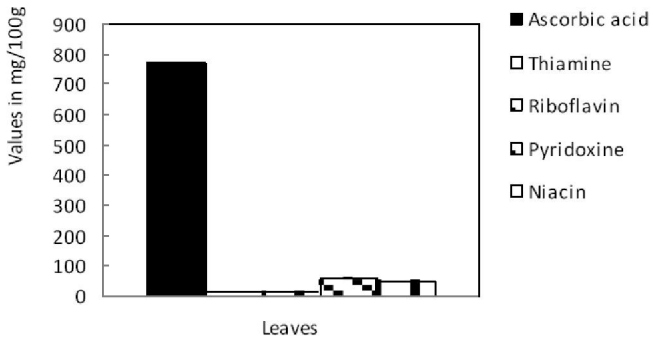

Figure 4 : The vitamin composition of *Moringa oleifera* leaves.

The levels of the anti-nutrients are shown in Figure 5. The level of tannins was highest (420mg/100g), followed by cyanogenic glycosides (32.40mg/100g), oxalates (11.80mg/100g), phytates (7.20mg/100g) and saponins (0.013mg/100g). These values indicated that *Moringa oleifera* leaves, apart from the high nutrient composition, is also medically and pharmacologically important. It is not a surprise that the plant is used in traditional medicine in Africa, Asia, and Americas[6,26]. Tannic acid is an astringent and is used in the treatment of bedsores and minor ulceration. Saponins are used in the manufacture of shampoos, insecticides and various drug preparation and synthesis of steroid hormone[27]; Phytic acid has complicated effect in the human system, particularly indigestion of food and flatulence[18,28]. Tannins have antagonistic competition with proteins, thereby, lowering their bio-availability, thus, eliciting protein deficiency syndrome and kwarshiorkor. However, these anti-nutrients can easily be removed by soaking, boiling or frying[29-32].

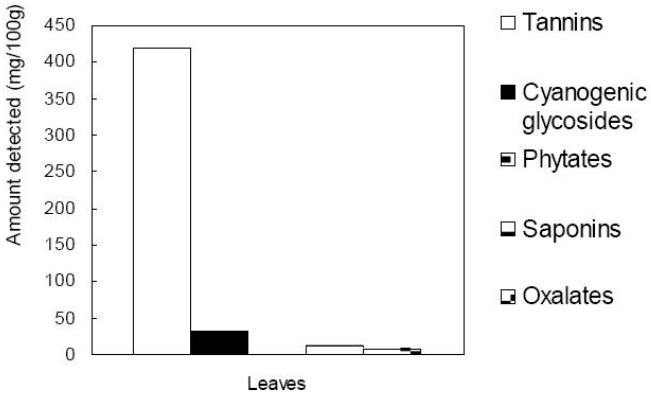

Figure 5 : The levels of anti-nutrients in *Moringa oleifera* leaves.

Figure 6 showed the growth rates of rats fed with the different feed diets. The leaf diet and the commercial rat pellets supported growth while the casilan diet did not support growth. The results obtained from animal feeding showed that the rats increased in weights after three weeks of feeding (from 46.73±3.81 to 66.59±5.27) when compared to the casilan diet (from

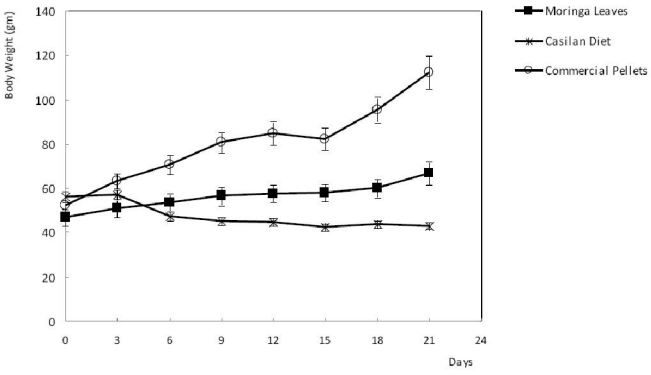

Figure 6 : The growth rates of rats fed with *Moringa leaf* diet, casilan diet, and commercial rat pellets through a period of 21 days (each point is the mean of the growth rates ± SEM: where n=5).

55.94±2.48 to 42.89±1.56). However, the commercially prepared rat pellets gave the best result, which increased growth rates of rats from 51.90±1.38 to112.14±7.36.

CONCLUSION

The proximate analysis and the animal feeding experiment suggested that the leaves of *Moringa oleifera* grown in Awka, Nigeria are rich in nutrients, just like those found in other parts of the world. Therefore, it is a complete nutritional supplement for both animals and man.

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