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Nutrient composition and anti-nutritional factors in a local cultivar of *Moringa oleifera* (Lam) flowers

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ABSTRACT

The methods of Association of Analytical Chemists were used for the proximate analysis of *Moringa oleifera* (Lam) flower and the amino acid content determined using Technicon Sequential Multi-Sample amino acid analyzer (TSM). The flowers contain $9.44 \pm 3.08\%$ fat; $25.99 \pm 0.07\%$ proteins; 50.57% carbohydrates; $3.57 \pm 0.12\%$ ash; $10.43 \pm 0.58\%$ moisture and $89.57 \pm 0.58\%$ dry matter. The total energy value of the flower is 391.20 kcal/100g. The flowers contain ascorbic acid (459.21mg/100g) and pyridoxine (7.69mg/100g), but lack niacin, riboflavin and thiamine. Calcium (2.32mg/100g), Potassium (3.02mg/100g) and Sodium (129.03mg/100g) were found in the flowers. Tannins (60mg/100g) and oxalates (51.23mg/100g) were present at higher levels, while saponins (15.20mg/100g) phytates (0.436mg/100g) and cyanogenic glycosides (4.31mg/100g) occurred at much lower levels. The results of analysis of variance indicated that there was no significant difference between the essential and non-essential amino acids present in the flowers since the significance value of the result was well over 0.05. Experimental studies with rats suggest that despite the appreciably high protein (25.99%) content of the flowers, it did not support growth. Rats fed compounded meal containing 38.5% of *Moringa* flower ration for 21 days presented with drastic reduction in growth rate with mean body weight declining from $55.20 \pm 1.60\text{g}$ to $39.70 \pm 1.15\text{g}$. The implication is that either the anti-nutritional factors interfered with normal metabolism or that the protein content of the flower is not digestible.

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KEYWORDS

Moringa oleifera;
Nutrient composition;
Anti-nutritional factors.

INTRODUCTION

Moringa oleifera plant belongs to the *Moringaceae* family which has about fourteen species, *Moringa oleifera* being the best known. Although, native to Sub-Himalayan parts of northern India, it is now widely cultivated in the tropics and sub-tropics^[1-4] be-

cause it tolerates a wide range of soil and rainfall conditions. *Moringa oleifera* is drought-resistant and in season all-year-round^[2,5,6]. It is resistant to drought because of the presence of a long tap root. It thrives within a temperature range of 25-35°C, but can tolerate up to 48°C in the shade and can survive a light frost. It is resistant to many pests^[1,4,7].

Moringa has been credited with a multitude of uses: the leaves, pods, flowers, and the growing tips of the tree are edible and nutritious^[1,4]. Apart from its dietary importance, local folklore credits *Moringa* with a lot of herbal potency^[1,3,6,7]. Because of the many uses of this plant, it is not a surprise that there is a rising interest in research, development, and utilization of the plant in many parts of the tropics^[7,8].

Moringa flowers are used in treating malnutrition in traditional settings^[1,6,9]. They are used as tonic, diuretic and considered to be anti-helminthic^[6,8]. Despite the wide claims on the nutritional and medicinal uses of the *Moringa* flowers, studies on the nutritional and bioactive potentials of this plant remain scanty. This work is therefore, aimed at documenting the nutrient and chemical compositions of *Moringa oleifera* flowers in a bid to determining its usefulness and suitability as an edible vegetable or otherwise.

EXPERIMENTAL

Sample collection and treatment

The mature *Moringa oleifera* flowers were collected from family gardens in Ifite, Awka, Anambra state, Nigeria. The flowers were air-dried at 30 °C (temperature) for two days and ground into fine powder using manual grinder. The milled samples were kept in screw-capped containers, stored in a deep freezer and analyzed within seven days.

Proximate analysis and mineral composition

The methods of the Association of Official Analytical Chemists^[10] were used for the determination of moisture, crude protein, crude lipids, ash and dry matter in the flowers. The mineral content was estimated using atomic absorption spectrophotometer (AAS)

Determination of amino acid content

The amino acid content of *Moringa oleifera* flower was determined using methods described by Speckman *et al*^[11]. The dried and milled flowers were 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 calorific value was estimated in kilocalories by multiplying the percentage crude proteins, lipid and carbohydrates by the recommended factors 4, 9, and 4 respectively^[12].

Vitamin analysis

The determination of the water-soluble vitamins namely niacin, pyridoxine, riboflavin, thiamine and ascorbic acid were by high performance liquid chromatography (HPLC), as described by AOAC^[13].

Determination of the anti-nutrients

The levels of oxalates^[14], phytates^[15], tannins^[16], saponins^[16], and cyanogenic glycosides^[16] in the flowers were determined using the prescribed methods.

Dietary evaluation using wistar albino rats

Fifteen (15) wistar albino rats with average weights of 54.54g were used for the experiment. They were divided into three groups, each group containing five rats. Casilan and commercially available rat diets were used as controls while the compounded *Moringa* flower diet was the test diet. The constituents of the compounded diets are shown in TABLE 1. The rats were initially fed with commercially available rat pellets for 7 days (acclimatization) before the use of the compounded diets. The feeding trials were done at 10% protein level and the trials lasted for three weeks. The weights of the rats were measured every three days until the end of the feeding trials and the growth pattern determined.

TABLE 1 : The composition of the compounded diets in g/kg diet (proximate composition).

Constituents	Flower diet (g)	Casilan diet (g)
Corn starch	508 (50.8%)	759 (75.9%)
Oil	100 (10%)	100 (10%)
Vit./Min. mix	30 (3%)	30 (3%)
Casilan	-	111 (11.1%)
Flower powder	362 (36.2%)	-

RESULTS AND DISCUSSION

Figure 1 shows the proximate composition of *Moringa oleifera* flower (Mean \pm S.E.M). It contains % fat (9.44 \pm 3.08), % crude proteins (25.99 \pm 0.07), % carbohydrates (50.57), % ash (3.57 \pm 0.12), and

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% moisture (10.43 ± 0.58). The energy value is 391.20 Kcal/100g. At 25.99%, *Moringa oleifera* flower grown at Awka has considerably high protein content and is a good source of protein since according to Pearson^[17], any plant food that provides more than 12% of its calorific value from protein is a good source of protein. The calorific energy value of the flower is 391.20 Kcal/100g.

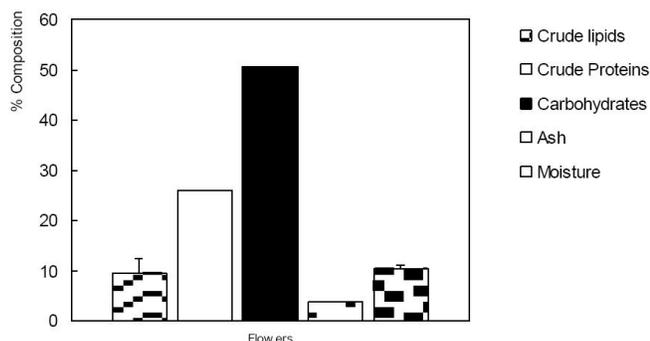


Figure 1 : The proximate composition of *Moringa oleifera* flower (Mean \pm S.E.M).

The amino acid profile of the *Moringa oleifera* flower is shown in Figure 2. It contains all the essential and non-essential amino acids. The highest amino acid is the acidic amino acid, glutamic acid (7.27g/100g protein), followed closely by arginine (6.30g/100g protein) and leucine (5.35g/100g protein). The high value of glutamic acid may be due to the conversion of glutamine to glutamate^[18,19,7]. Leucine, a ketogenic, branch chain amino acid can lead to ketoacidosis due to high synthesis of ketone bodies. These acids lower the pH and can lead to seizures and may be fatal. The results of analysis of variance indicate that there is no significant difference between the essential and non-essential amino acids present in the flowers since the significance value of the result is well over 0.05.

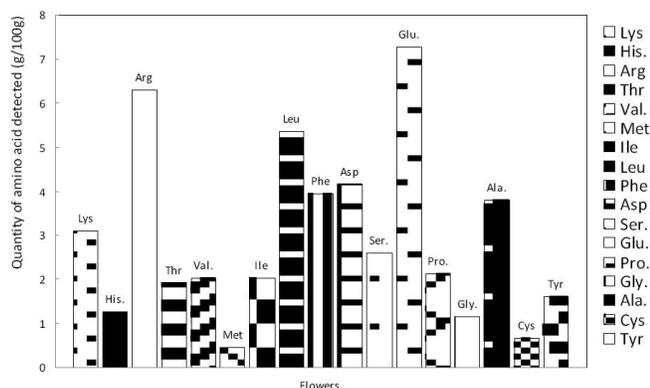


Figure 2 : The amino acid profile of *Moringa oleifera* flower.

The mineral composition of the *Moringa oleifera*

flower is shown in Figure 3. The flower contains sodium (120.93mg/100g), calcium (2.32mg/100g) and potassium (3.02mg/100g). The vitamin content of the flower is shown in Figure 4. In this particular study, only ascorbic acid (459.21mg/100g) and pyridoxine (7.69mg/100g) were detected in the flowers.

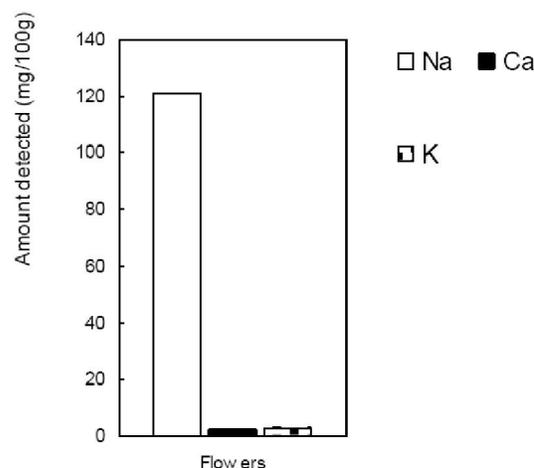


Figure 3 : The mineral composition of *Moringa oleifera* flower.

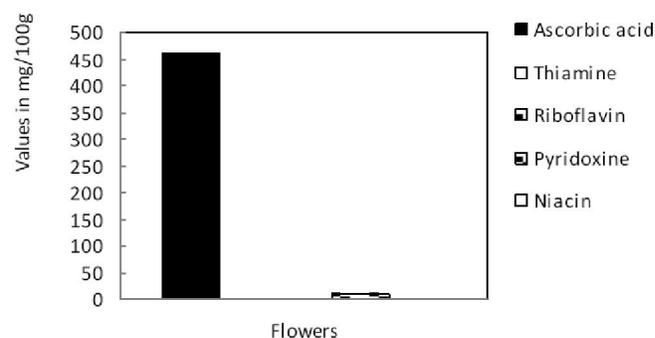


Figure 4 : The vitamin composition of *Moringa oleifera* flower.

The levels of the anti-nutrients are shown in Figure 5. Tannins (60mg/100g) and oxalates (51.23mg/100g) are higher in the flowers of *Moringa oleifera*. The values for cyanogenic glycosides, saponins and phytates are considerably lower, (4.31mg/100g, 15.20mg/100g and 0.436mg/100g respectively). Tannins lower the bioavailability of protein. Phytic acid and oxalates have complicated effects in the human system, particularly indigestion of food and flatulence^[20,19].

Figure 6 shows the growth rate of rats fed with *Moringa* flower diet (test) and commercial rat pellets and casilan diet (controls). The flower and casilan diets did not support growth. The rats on the test diet showed a decrease in weights from 55.20 ± 1.60 g to 39.70 ± 1.15 g over a period of 21 days while rats on commercial diet (control) increased from 51.90 ± 1.38 to

112.14 ± 7.36 within the same period. The casilan diet also decreased the growth rate of the rats from 55.94 ± 2.48 to 42.89 ± 1.56. The result from the flower diet showed that, although the flowers contain high amount of proteins, it did not support growth. This may be due to the presence of some of the anti-nutrients such as tannins and oxalates^[19,20]. Tannins can prevent protein digestion by chelating and precipitating them, thereby making them unavailable to the body. Oxalates react tightly with divalent ions such as calcium and zinc ions, thereby making them unavailable to the body^[19]. However, these anti-nutrients can be removed through soaking, boiling or even frying^[21-23].

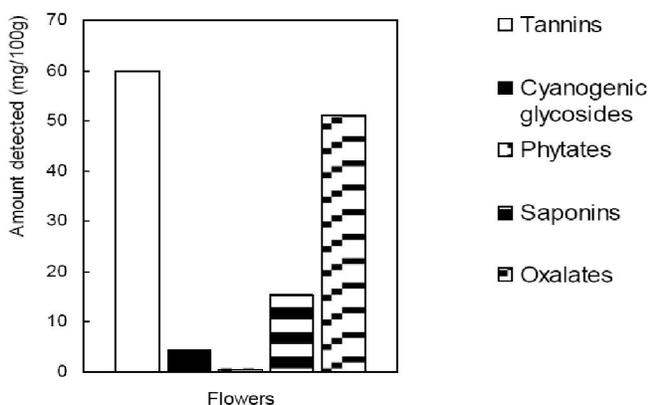


Figure 5 : The levels of anti-nutrients in *Moringa oleifera* flower.

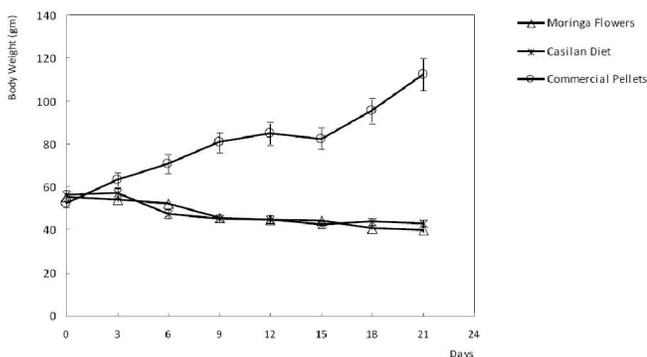


Figure 6 : The growth profile of rats fed with casilan, commercial rat pellets and meal ration containing *Moringa* flower through a period of 21 days (each point is the mean of the growth rates ± SEM: where n=5).

CONCLUSION

The proximate analysis shows that *Moringa oleifera* flower grown in Awka, Nigeria is rich in nutrients particularly proteins and carbohydrates, but when subjected to animal feeding, decreased growth

in rats. This may be due to the presence of the anti-nutrients such as tannins and oxalates that interfere with protein digestion. The effects of processing on the nutritional values of the flowers should be done to ascertain the suitability as a complete nutritional supplement for both human and animals.

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