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Research Article

A COMPARATIVE PROXIMATE ANALYSIS OF BARK, LEAVES AND SEED OF MORINGA OLEIFERA

Fagwalawa L.D., *Yahaya S.M. and Umar D.I.
Department of Biology, Kano University of Science and Technology, Wudil P. M. B, 3244
**Author for Correspondence*

ABSTRACT
The comparative analysis of the proximate composition of bark leaf and seed of *Moringa oleifera* was carried out by the method of association of official analytic chemist (1984 and 1990). The proximate analysis revealed the presence of ash, moisture, crude fiber, crude protein and total carbohydrate content of the seed (26.45%) was found to be significantly ($p< 0.05$) higher in the seed compared to the bark (18.74%) and leaf (23.8%). The fat (19.63%) and moisture (9.08) content of the seed were found to be significantly higher ($p< 0.05$) than that of the bark fait (3.4%) and moisture 4.74" and leaf fait (6.83%) and moisture (6.88%) respectively. The crude protein (43.53%) in leaf was significantly ($p< 0.05$) higher than crude protein in bark (21.88%) and seed (30.09%). The crude fibre in the bark (44.75%) was significantly higher ($p< 0.05$) in the bark compared to be that in leaves (7.93%) and seeds (6.04%). This showed that the seed has more nutritious component and this finding could go a long way in improving nutritional requirement of people.

Keywords: *Fat, Moringa Oleifera, Moisture Content, Protein*

INTRODUCTION
Moringa belong to family moringaceae, genus *Moringa*. *Moringa oleifera* is one of the most widely cultivated species of a monogenetic family. The moringaceae that is native to the Sub Himalayan tracts of India, Pakistan, Bangladesh and Afghanistan (Rajagam *et al.*, 2001). This fast growing tree is gown throughout tropics for human food, livestock forage, medicine, dye and water purification. It is known by several names in different countries but popularly called drumstick tree for it pod that are used by drummers and horse/radish tree for the flavour of it roots (Rajagam *et al.*, 2001).
Moringa is one of world's most nutritional crops, once for once, the leaves of Moringa have more better carotene than carrots. More protein than peas. More iron than spinach. The tree is becoming vital sources of nutrition in this region. Where most of the world's poor people live (Palade and Chang, 2003).
Moringa oleifera is a soft wood tree with tender pods. *Moringa* is a very popular vegetable in south India cuisine and valued for their distinct inviting flavour. This is a backyard tree for daily use in morethan two million homestead of south India. An ancient literature mentioned Moringa as an interesting plant due to its wide spread use in agriculture. Medicine and industries it is a short slender. Deciduous, perennial tree growing up to 10 m tall rather slender with dropping branches: branches stems brittle. With corky bark: leaves feathery, pale green, compound, tripinite 30-60 cm long, with many small leaflets, 1.3-2 cm long. Lateral ones somewhat ellipticterminal one obovate and slightly larger than the lateral ones: Flower fragrant, white or creamy – white 2.5cm in diameter, borne in sprays, with 5 at the flower, stamen yellow; pods pendulous, brown, triangular, splitting lengthwise into 3 part when dry, 30-120cm long. 1.8cm wide, containing about 20 seeds embedded in the pith pod tapering at both ends. 9-ribbed; seed dark brown terminal one obovate and slightly larger than the lateral ones: Flower fragrant, white or creamy- white. 2.5cm in diameter, borne in sprays, with 5 at the flower; stamen yellow: Pods pendulous, brown, triangular splitting lengthwise into 3 parts when dry. 30-120cm long. 1.8cm wide .containing about 20 seeds embedded in the pith, pod tapering at both ends. 9-ribbed: seed dark brown with 3 papery wings.
Moringa is undergoing preliminary research to reveal potential properties of its nutrients and phytochemicals, some of which include antibiotic effects in *in vitro*, improving glucose tolerance in a rat

model of diabetes, inhibition of Epstein - Barr Virus activity in *in vitro* and reduction of skin Papi llomas in mice (Duke *et al.*, 2002).

Moringa is important vegetable in Africa, Central America, China and India and is one of the most important vegetable grown in the world. It is widely used as a source of food for both human and animal. The bark, leaves and seeds may have different nutritional compositions hence the need out a comparative assessment of the proximate analysis of the bark, leaves and seeds of *Moringa*. This research is aimed at determining and comparing the proximate and mineral elements composition of leaves and seeds of *Moringa* with specific objectives of estimating the levels of protein, fats, carbohydrate, moisture and ash of the secured samples, comparing the results obtained from the bark, leaves and seeds in order to assess the nutritional value of each of the proximate composition.

MATERIALS AND METHOD

Collection of and Preparation of Plant Material

Dried bark, leaves, and seeds of *Moringa* were purchased from a garden which were separately grounded into powder using mortar and pestle. The powder obtained was kept in the laboratory at room temperature and used for proximate analysis during the period of the research.

Proximate Analysis and Determination of Moisture Content

This was carried out by the method of A.O.A.C (1984). It involved the measurement of weight loss due to evaporation of moisture. An air dried oven was used and the loss of weight after drying to a constant weight gave the quality of moisture present in the sample. A clean dried petri - dish was weighed as (W1), sample of (5g) was placed in it. In the case of leaf, bark and seed respectively. The petri - dish together with the sample was weighted as (W2) each was then taken into the oven and heated at 120 ^{0}C for 3 hours. It was removed and cooled in desiccator for 30 minutes and finally weighted (W3). The present moisture content was obtained as below

W1 = initial weight of the dish (in grams)
W2 = initial w eight of the dish + sample (before drying)
W3 = final weight of the dish + sample (after drying)

$$\%\text{moisture content} = \frac{W2 - W3}{W2 - W1} \times 100$$

Determination of Ash Content

This was determined by also using the method of A.O.A.C (1984). The ash content of food stuffs is the inorganic residue remaining after the organic matter has been burnt off, which can be determined by heating known amount of dried sample in a muffle furnace at 550 ^{0}C. A clean dried crucible was weighed as W1. Each of the samples was placed in the muffle furnace and heated at 550 ^{0}C until organic matter was burnt off. The ash was then placed in a desiccator prior to weighing and after cooling this was weighed as W3. The present ash content in each sample was obtained as below;

W1 = weight of crucible (gram)
W2 = Weight of crucible + sample (gram)
W3 = weight of ash (gram)

$$\% \text{ Ash content} = \frac{\text{Weight of ash}}{\text{Weight of sample}} \times 100 = \frac{W3-W1}{W2-Wl} \times 100$$

Three grams of each of the Sample was carefully weighed as W1 placed into a folder a fat free filter paper and a small cotton wool placed on top. This was properly tied with a thread at both ends and weighed as weight of W2. It was then carefully placed in the extraction thimble and small cotton wools placed on top. The whole apparatus was connected after addition of about 300cm' of 60° — 80°C petroleum ether. The

extraction was carried out for 3 hours using the heating mantle and making sure that there was continues flow of water in the condenser, the sample was removed, air - dried and then placed in an oven at 80°C until a constant weight was obtained. The percent crude lipid was obtained as per below:

W1 = weight of sample (gram)
W2 = weight of sample + filter paper (Before extraction)
W3 = weight of sample + filter paper (after extraction)

$$\% \text{ crude lipid (fat)} = \frac{W2 - W3}{W1} \times 100$$

Determination of Crude Protein

This was determined by the method of Egan *et al.*, (1981). It was done using Kjeldhal procedure, like, the sample was heated with ion. H_2S04 in the presence of metallic catalyst. This reduces organic Nitrogen to form ammonia. The ammonia was retained in the solution in form of NH_3SO_4. The alkaline was distilled to release ammonia which was trapped in a standard acid and titrated. The Sample (0.15g) was weighed and transferred into Kjeidahl digestion flask. Catalyst (0.8g) mercury oxide and concentrated sulphuric acid ($2cm^J$) were also added into the kjeidahl digestion flask. The mixture in the digestion flask was heated on the heating mantle for l hour until the liquid became clear. The digest was cooled and made alkaline 40% NAOH (15cnT). The digest was then transferred to steam apparatus using minimum volume of water. Ammonia steamed distilled into 2% boric acid~($10cm^3$) with 5 drops of methyl red indicator for 15 minutes. The distilled ammonia was then titrated with hydrochloric acid (0.02m). The result was used to obtain the protein as per the formula given below:

$$\% \text{ protein} = \frac{Pg}{\text{Weight of sample used}} \quad X\ I\ 0\ 0$$

Where;
Pg - crude protein content

Determination of Crude Fiber

This was determined by the method of A.O.A.C (1990). Crude fibre was the insoluble and combustible organic residue, which remains after the food has been heated under prescribed condition. These conditions are consecutive treatment with light petroleum, boiling in dilute sulphuric acid, sodium hvdroxide and ether. A sample of three grams (3g) was weighed into the extraction apparatus and extracted three times with light petroleum ether by stirring settling and decanting, the air – dried extracted sample was transferred to a dry $100cm^3$ conical flask 0.1275m sulphuric acid ($80cm^J$) was measured at ordinary temperature and brought to its boiling point. This was boiled for 30 minutes. While a constant volume maintained in the flask was rotated every few minutes in order to mix the contents and remove particles from the side. Buchner funnel was fixed to a perforated plate and to the funnel a filter paper was also fixed to cover the holes in the plate. The mixture was poured immediately into the prepared funnel. The tunnel was adjusted so that filtration was completed within 10 minutes; the insoluble matter was washed with boiling water for several times until the washings were free of acid. It was then transferred back to the conical flask and 0.313 sodium hydroxide ($80cm^J$) measured at ordinary temperature brought to boiling point added. The mixture was boiled for 30 minutes; it was allowed to stand for 1 minute and then filtered immediately. The insoluble material was transferred to the filter paper by means of boiling water, and then it was washed with 1% hydrochloric acid and washed again with boiling water until it was free from acid. It was then washed twice with ethanol and three times with ether, the insoluble matter was then transferred to a dried, weighed crucible and dried at1000°C to a content weight. Its content was placed on a heating mantle in a fume cupboard and burnt off the organic matter. It was then transferred to a muffle furnace at 550°C for 3 hours the ash content after cooling was then determined by weighing, as follows:

Wl — weight of sample extraction ± filter paper
W2 = weight of Wl after ashing
W3 = weight of sample used (3g).

$$\% \text{ crude fiber} = \frac{W1 - W2}{W3} \times 100$$

Determination of Total Carbohydrate

This was also determined by the method of A.O.A.C (1984). The percentages of the remaining constituents are summed up and subtracted from 100%. The value obtained from gave the crude carbohydrate content of the sample. % carbohydrate = 100 - (%moisture + %ash + %fiber ± %protein + %fat).

RESULTS AND DISCUSSION

Result

The results presented in mean values ± standard deviatior (SD) revealed that the leaf of *Moringa* is an excellent source of protein as it contained (43.53 ± 0.22%) protein. The leaf contained appreciable amount of crude fibre (7.93 ± 3.91) and moisture. (6.83 ± 0.52%). The table also shows (7.12 ±2.8%) ash and (23.8 ± 0.18) carbohydrate (Table 1).

Table 1: Shows the Results of the Total Proximate Analysis of the Leaf of Moringa.

Nutrient Analyzed (DW)	Mean Composition (% ± SD)
Crude Protein	43.53 ± 0.22
Crude Fat	6.83 ± 0.27
Crude Fibre	7.93 ± 3.91
Moisture	6.12 ± 2.8
Ash	23.8 ± 0.1
Carbohydrate	23.8 ± 0.1

The result also in the form of mean values ± standard deviation (SD) shows (30.09 ± 0.19%) protein. (19.63 ± 0.19%) crude fat. (9.08 ± 1.66%) moisture, (4.64 ± 2.28%) ash and (26.45 ± 1.1%) carbohydrate (Table 2).

Table 2: Shows the Result of the Total Proximate Analysis of the *Moringa* Seed

Nutrient Analyzed (DW)	Mean Composition (% ± SD)
Crude protein	30.09 ± 0.19
Crude fat	19.63 ± 1.66
Crude fibre	6.04 ± 1.66
Moisture	9.08 ±0.02
Ash	4.64 ±2.28
Carbohydrate	26.45 ± 1.0

The result of the analysis from bark of Moringa (Table 3) indicate that, the bark contained appreciable amount of protein (21.88 ± 0.43%), it showed (3.40 ± 0.23), crude fat and it also contained high percentage of fibre (44.75± 0.05) moisture content was found to be (4.74 ± 0.76%) Ash (5.02 4.74 ± 0.76 0.1%) and carbohydrate (18.74 ±1.47).

Table 3: Proximate Analysis of Bark of *Moringa oleifera*

Nutrient Analyzed (DW)	Mean Decomposition (% ± SD)
Crude protein	21.88 ±0.43
Crude fat	3.40 ±0.23
Crude fibre	44.74 ±0.05
Moisture	4.74 ± 0.76
Ash	5.02 ± 0.1
Carbohydrate	18.74± 1.47

Discussion

The proximate analysis of the leaf of *Moringa* revealed the leaf of *Moringa* as an excellent source of protein. The result has agreed with the report of Rashid *et al.,* (2008) who counted *Moringa* as a counting *Moringa* a food products good for those suffering from malnutrition due to its high protein content. The result also conformed to the report of family and will in (2009) who also reported that *Moringa oleifera* leaf has about 40% protein with all of the essential amino acid.

The leaf also contained appreciable amount of crude fibre *Ibox et al.,* (2008) also reported that the leaf of *Moringa* has crude fibre higher than 3.5% reported by (Elkhulifu, 2007; Park, 2011) from the moisture content, that leaf can be described as poler table, in accordance of (7.6± 0.6%) and (6.6 ± 0.6%) Adeyoye and Omotayo (2011) reported moisture content in the leaf of *Moringa* within the range of (7.6±0.6%) and (6.6 ± 0.6) this is an appreciable amount that can efficiently perform the required solvent processes. The value of Ash indicated the leaf as rich in other minerals element forming the skeletal frame of the leaf. Carbohydrate of the leaf (23.8 ± 0.1%) varied from the report of Lowell (2009) who found carbohydrate content to be 38.2%. The variation in the value of carbohydrate may be as a result of the extraction method of other nutrients. However, this composition is an appreciable amount to provide enough carbohydrate (a source energy making) required for normal development of a body.

The result of the present study (Table 4.2) shows proximate analysis of seed of *Moringa.* The seed had (30.09 ± 0.19%) protein which is contrary to the report of Nweze *et al.,* (2014) that the seeds contain 37.6% of crude protein. The variation in the proteins may be as a result of difference in variety of plant and extractor method.

Crude fat of the seeds was (19.63 ± 1.66%) which is supported by the report of Abdulkarim *et al.,* (2005) that the mature seed of *Moringa* yields 22 -38% oil. The percentage of oil makes the seed a distinct potential for the oil industries. The variation in oil yield may be due to the differences in variety of plant, cultivations climate, ripening stage and the extraction method used. The dried seed have (9.08 ± 0.02%) appreciable amount of crude fibre. Fibre taken as part of diet cleanses the digestive tract by removing potential carcinogens from the body and hence, prevents the absorption of excess cholesterol. The moisture was (9.08 ± 0.02%) which is quite lower than 5.3% as reported by Affiku and Ogbe (2011). Moisture in the food determines the rate of food absorption and assimilation within the body. It also determines the keeping quality of food. The reported value indicated that *Moringa oleifera* seed protein concentrate may not be stored at room temperature for a long period of time.

Ash had (4.64 ± 2.28%) which is slightly varies with report of Nwezeand Nwafor (2014) that the dried seed had 4.2% ash. The percentage ash indicated that the seeds were rich in minerals and analysis to determine its elemental or mineral composition is very important. The result reveals (26.45 ± 1.1%) carbohydrate which is higher than 13.6% as reported by Lowell (2001). The difference in value of carbohydrate may be due to differences in variety of plant and the extraction method.

The result of proximate and elemental analysis of bark of *Moringa* (Table 4.3) showed that, the bark of *Moringa* contained appreciable amount of protein of (21.88 ± 0.23%). Proteins perform a great variety of specialized and essential function in the living cells. They are responsible for structure and strength of

body proteins can also acts as an enzymes, hormones, blood clotting. Factor and immunoglobulin (Stayaparayana and Chakrapi, 2007). It also contained (3.40 ± 23%) crude fat. Lipid constitutes a broad of naturally occurring molecules that include facts, waxes sterols. Fat soluble vitamins (such as vitamin A, D, F and K. monoglycerides, digycerides, triglycerides phospholipids and others) (Kliman, 2009). The bark of *Moringa* contained high percentage of fibre (44.75 ± 0.05%), hence, it is an excellent source of fibre and the result has agreed with the report of Amanda (2011) that crude fibre is found in the cells walls of fibre molecules, including cellulose and lignin and it binds to water as it passes through the digestive tract. Lorraine (2010) reported that excellent sources of crude. Fibre or insoluble fibre include vegetables like leafy greens, whole grains like whole wheat and black beans, thus, another excellent source is to bark of *Moringa*.

The moisture was (4.74 ± 0.76%). Moisture in food determines the rate of food absorption and assimilation within the body; it also determines the keeping quality of food. The reported valued indicated that the bark of *Moringa oleifera* may not be stored at room temperature for a long period of time.

The result also showed (5.02 ± 0.1%) ash. The ash percentage indicated the bark was rich in minerals and hence, it was important to carry out an elemental analysis to determined its elemental or mineral composition. The bark had (18.74 ± 2.8%) in the bark Limpkin and William (1990) reported that carbohydrates perform numerous roles in living organisms. They are the most abundant bulk nutrients, the major sources of biological energy through their oxidation in tissue. The leaf of *Moringa oleifera* was more notorious than its bark and seed, thus, leaf protein concentration of *Moringa* is naturally adequate and given the promising source of dietary minerals in most developing countries. It is however important to stress that leaf protein concentrates is not food on their own but if contains nutritional potential that could find application in food.

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