

EFFECT OF DRYING METHOD ON THE NUTRIENT CONTENT OF *MORINGA OLEIFERA* LEAVES

*¹Buda, Muhammad Kabir, ²Rashidu Mamman, ³Shehu Ibrahim Kura and ⁴Titus Matthew

^{1,2,3 & 4}Department of Biology

Niger State College of Education, Minna, Niger State

E-mail: mohakebs@gmail.com

Abstract

This research work is on the effect of drying method on the nutrient content of Moringa oleifera leaves. It covered some specific farms in kadna village in Bosso Local Government Area of Niger State. The finding on the effect of drying method on the nutrient content of Moringa oleifera leaves were discussed and analyzed. These findings revealed that drying of Moringa oleifera leaves does make the moringa leaves lose its nutrient content, it only lost its moisture content. The research also provides some useful recommendations based on the findings which include enlightenment on the economic and nutritional importance of the drying and preserving of the Moringa oleifera leaves.

Key words: *Moringa oleifera*, Leaves, Nutrient, Contents, Drying

1. Introduction

Moringa oleifera is native to the Indian subcontinent and has become naturalized in the tropical and subtropical areas of the world. “*Moringa*” belongs to the kingdom *Plantae*, Order *Brassicales*, Family *Moringacaceae*, Genus *Moringa* and Species *Moringa oleifera*.

It is the most widely cultivated species of the Genus *Moringa*, which is the only genus in the Family *Moringacaceae*. It is an exceptionally nutritious vegetable tree with a variety of potential uses. *Moringa oleifera* trees are well naturalized in the northern parts of Nigeria where the leaves are popularly known as ‘zogala’ and widely consumed by populace (Pallavi and Dipika, 2020)

The plant is described as a fast-growing plant and drought resistant crop variety. It can survive in less fertile soil (Fahey, 2015, Anwar et al., 2017). The tree itself is rather slender, with drooping branches that grow to approximately 10-12m in height. The “moringa” tree is grown mainly in semi-arid, tropical and subtropical areas. While it grows best in sandy soil, it also tolerates poor soil, including coastal areas. *Moringa oleifera* tree has a wide-open typically umbrella-shaped crown and usually, a single stem which tends to be deeply rooted. The wood is soft and its bark is light (Anwar et al., 2017). The *Moringa* leaves are excellent, concentrated source of proteins,

vitamins and minerals. Out of the 120 vegetables species tested for their nutrients content antioxidant activity, and the facility with which they are grown and processed, *Moringa oleifera* leaves will be top ranked by the World Vegetable Centre (AVRDC) (Moyo, et al., 2017).

Moringa oleifera provides the body with chemical substances known as nutrients, which in turn furnish the body with energy, regulate body processes, promote growth and repair body tissues. When the food is selected wisely and consumed in sufficient quantity, it provides all the nutrients which the body needs in the proportion required to function properly (FAO, 2018). Some of the nutrients supplied by the food are called essential nutrients because they cannot be synthesized in the body, at least in the amounts needed, and they enable the body to maintain good health. Other nutrients used by the body are known as non-essential nutrients.

Fahey (2018) considered *Moringa oleifera* leaves to contain significant source of essential nutrients such as Vitamin C, protein, iron, potassium, calcium and phosphorus and are commonly dried and crushed into powder and stored without refrigeration for months without loss of nutritional values). The leaves contain 7.5 mg water, 6.7 mg protein, 1.7 mg fat, 14.3 mg total carbohydrate, 0.9 mg Fibre, 2.0 mg ash, 440 mg Calcium, 70 mg Phosphorous, 7 mg Iron, 110 mg Copper, 5.1 mg/l, 11.300 mg vitamin A, 120 mg vitamin B, 0.8 mg nicotinic acid, 220 mg ascorbic acid and 7.4 mg tocopherol per 100 mg. Estrogenic substances, including the anti-tumor compound, beta-sitosterol, and a pectin esterase are also reported. The leave also contains amino acid include 6.0 mg arginine, 2.0 mg methionine, 4.9 mg threonine, 9.3 mg leucine, 6.3 mg isoleucine and 7.1 mg valine (Olushola, 2006).

Consequently, it is edible and is used in the manufacture of perfumes and hairdressings. Wood yields blue dye (Duke, 2020). The roots are shredded and used as a condiment; however, it contains the alkaloid called spirochim, a potentially fatal nerve paralyzing agent. The flowers can be processed and used for the production of pesticides because they contain natural chemical for which insects and other pest cannot withstand (Adeniyi, 2020).

However, with the renewed campaign and interest in *Moringa oleifera* consumption, it may become increasingly difficult to produce sufficient leaf powder by drying naturally under the shade to meet the growing demand. Therefore, it is needed to conduct a laboratory study on the effect of drying temperature on the nutrient content of *Moringa* leaves. This study will be useful when considering industrial drying of the leaves for large scale production of *Moringa oleifera* leaf powder. It will serve as a guide to industrialist to select optimum drying temperature to maximize nutrient retention.

2. Statement of the Research Problem

The need to meet nutritional requirements through adequate food supplies and proper selection of diet has been a basic determinant of stability and progress, since human being require food to pursue essential functions such as growth, development and reproduction (Onimawo, 2019). Hunger and malnutrition are highly prevalent in the developing countries. *Moringa Oleifera* leaves is use for many purposes including medicine, food, oil and industrial purpose etc. Leafy vegetables are very much prone to attack by pathogens especially fungi if not adequately preserved. The best drying method if applied will go a long way in ensuring the food security of the local people.

3. Research questions

1. What is the effect of various drying methods on the proximate composition of the leaves of *Moringa oleifera*?
2. What is the effect of various drying methods on the Nutrients composition of the leaves of *Moringa oleifera*?

3.1 Significance of the Study

This study will be of benefit to the following stake holders

1. Famers: This study will be of benefit to famers in providing them firsthand information on ways and needs for drying Methods.
2. Agricultural Extension worker: will be equipped with education on the available drying methods for formers to utilized.
3. The study will also serve as a reference point for researchers who intend to go further with research study on the problems relating to *Moringa oleifera* leaves

4. Methodology

The study employed the methodological approach under the following headings. Collection and Identification of Plant Sample, Preparation of Leaves for Drying, Drying Methods, Determination of nutritional composition,

4.1 Collection and Identification of Plant Sample

Fresh, mature and healthy leaves of *Moringa oleifera* were used for this study. The leaf samples were collected from 'Kadina' village in Bosso Local Government Area of Niger State in Northern Nigeria in the morning when the average temperature is 22°C. The samples were collected at the same time to avoid the effect of environmental factors. Also, they were collected at the same place and from the same tree to avoid the effect of soil variation on the micronutrient content of the leaves. The samples collected was taken to the laboratory for further analysis.

4.2 Preparation of Leaves for Drying

Fresh, green, un-wilted, and non-insect infested leaves were selected while the bruised, discoloured, decayed and wilted leaves were discarded before washing. The stalks of the leaves were cut from the main branches and the leaves washed thoroughly with plenty of water to remove all the adhering dust and dirt particles. Thin branches of the *Moringa* leaves were kept intact during washing for easy handling of the leaves. The excess water was drained out from leaves. After removing the excess moisture, all the stems and branches of the leaves were removed and only the leaves of *Moringa oleifera* were dried.

4.3 Drying Methods

The drying methods used in the present study were:

- i. **Sun Drying:** - The leaves were placed on a sheet of cloth and placed under direct sunlight on a roof away from animals, traffic and dust. The leaves were turned occasionally to ensure even drying. The leaves were brought indoor at nights as the temperature during night falls down. Sudden temperature change could put moisture back into the leaves and lengthen the drying time. The leaves took four days to dry in the sun (Pallavi and Dipika, 2019)
- ii. **Shade Drying:** - The leaves were spread on a sheet of cloth and kept in a well-ventilated room at a temperature $25 \pm 20^{\circ}\text{C}$ for days. Natural current of air was used for shade-drying the leaves. It took six days for the leaves to dry completely and become crisp and brittle to touch.
- iii. **Freeze drying:** - Freeze drying the fourth sample was performed by pre-freezing the sample for an hour and then drying for about 6hrs at sample temperature of 15°C and condition temperature of -60°C
- iv. **Oven Drying:** - The leaves were oven dried (60°C) using hot air oven (Stuart Scientific, England) for 24hrs to obtain a completely dry sample (Hassan, 2017).

4.4 Determination of Nutritional Composition

The fresh and the dried leaves were analysed for proximate composition (moisture, protein, fat, fibre, carbohydrate and ash), using the methods described by Association of Official Agricultural Chemists (AOAC, 2000).

- Calcium, Phosphorus, Potassium, Iron, and Magnesium of the samples were determined according to methods recommended by the same body.
- Atomic Absorption Spectrophotometer (AAS) was used to determine Iron (Fe), calcium (Ca) and magnesium (Mg). Phosphorus (P) was determined using calorimeter.
- Potassium (K) was determined with a flame photometer.

5. Result and Discussion

1. Effect of various drying methods on the proximate composition of the leaves of *Moringa oleifera*.

The proximate analysis consists of experimental determination of moisture, fat, crude protein, crude fibre, ash and carbohydrate.

Table 1 show the result of the proximate analysis of samples from the fresh moringa leaves and the four drying methods (freeze, oven, sun and shade drying) used in this study.

Table 1: Proximate composition of moringa leave samples from different drying techniques

Sample

	M.oisture content (%)	Fat (%)	Crude protein (%)	Crude fibre	(%) Ash	(%) CO	(%) Total
Fresh leave	72.50	7.48	6.34	7.30	1.23	5.15	100
Freeze dried	5.88	8.15	27.02	13.39	8.36	37.20	100
Oven dried	5.37	8.86	24.94	14.76	9.33	36.74	100
Sun dried	6.43	8.96	26.06	12.65	8.92	36.98	100
Shade dried	7.23	8.62	27.56	12.49	8.41	35.69	100

A reduction in the moisture content of the fresh leaves from 72.50% to a minimum amount of 5.37% was achieved by oven drying. Freeze drying, sun drying and shade drying *Moringa* leaves also reduced their moisture content to 5.88%, 6.43%, and 7.23% respectively. Moisture is a basic requirement for the growth and development of vegetable pests and bacteria. Since leafy vegetables are seasonal and highly perishable, special processing (e.g., drying) is required to minimize their vulnerability to bacteria and pests attack, which could bring about decaying or losing the nutritional values. The crude protein composition ranged from 6.34% to 27.56% with shade dried samples having the highest value of 27.56% and the fresh leaves samples having the least at 6.34%. The freeze dried, oven dried and sundried samples had their protein content as 27.02%, 24.94%, and 26.06% respectively as shown in Table 1. Apparently, drying of *Moringa oleifera* leaves increases the protein content. This is because the loss in moisture content in the processed leaves increases the nutrient density of the leaves. The oven dried had the least value of protein content among the dried samples and this might be as a result of the high temperature in the oven. Air dried and freeze-dried sample have relatively higher percentage of protein content perhaps, because of the lower temperature involved in the drying processes. *Moringa oleifera* is a good source of protein having a protein content twice than found in yoghurt (Fuglie, 1999). Fat was also retained in the dried samples of *Moringa* leaves. The fresh leaves have fat content of 7.48% Whereas the freeze dried, oven dried and shade dried *Moringa* leaves contained 8.15%, 8.86%, and 8.62% respectively of fat. Sun dried leaves however, demonstrated highest percentage of 8.96% fat. The fat content of *Moringa* leaves is relatively low compared to the protein content. This suggests that the leaves can be consumed as a better diet for individuals that require low fat diet. Similarly, the analysis for crude fibre showed that it was preserved in the dried leaves. Fresh leaves sample had the least fibre content of about 7.30% while the oven dried *Moringa* leaves had the highest content of 14.76%. It implies that the fibre concentration almost doubled by drying the leaves. The freeze dried, sun dried and shade dried *Moringa* leaves had their crude fibre content as 13.39%, 12.65%, 12.49% respectively. Fibre has been reported to cleanse digestive tract by removing potential carcinogens from the body and hence prevent the absorption of excess cholesterol. In addition, fibre adds bulk to food and reduces the intake of excess starchy food,

which is a characteristic diet for low-income earners (Sodamade *et al.*, 2013). Hence supplementing diet with *Moringa* leaves will guard against metabolic conditions such as hypertension and diabetes mellitus. The ash content ranges from 1.23% - 9.33%. The fresh leaves sample had ash content of about 1.23%. The oven dried *Moringa* leaves again had the highest ash content of about 9.33% followed by sun dried (8.92%) then shade dried (8.41%,) and lastly freeze-dried samples (8.36%).

5.1 Elemental analysis

The elemental analysis consists of the determination of the elements present in a sample e.g. iron, potassium, calcium, magnesium, nitrogen, sulphur, manganese, zinc phosphorus, sodium etc. In this study, only five elements were considered which includes iron, potassium, phosphorus, magnesium and calcium. Table 2 shows the result of the elemental analysis of the fresh leaves and the four different drying methods employed.

2. Effect of various drying methods on the Nutrients composition of the leaves of *Moringa oleifera*.

Table 2: Elemental composition of *Moringa* leaves samples from different drying techniques

Sample	Potassium (%)	Phosphorus (Mg/g)	Iron (Mg/L)	Magnesium (Mg/L)	Calcium (%)	Total
Fresh leaves	1.28	2.50	5.17	5.04	2.30	100
Freeze drying	2.40	5.40	6.27	5.19	4.65	100
Oven drying	1.60	3.56	5.27	5.35	3.20	100
Sun drying	2.35	0.45	5.33	5.28	3.95	100
Shade drying	2.85	4.83	6.17	5.39	4.23	100

The potassium content of the fresh *Moringa* leaves and the dried leaves using the four drying methods varied from 1.275% to 2.85%. The fresh leaves had the lowest value of 1.275% while the shade dried leaves had the highest value of 2.85%. The freeze dried, oven dried, and sun dried moringa leaves had potassium content of 2.40%, 1.60%, and 2.85% respectively. From the result it can be seen that reducing the moisture content of *Moringa* leaves had effect on the potassium concentration. The dried leaves had more potassium content than the fresh/unprocessed leaves. Among the dried leaves, the oven dried sample had the lowest value of potassium content; this is due to the high heat applied for the drying of the leaves. The potassium content of *Moringa* leaves obtained in this study is within reasonable range as that reported by Moyo et al., (2011). Potassium is a mineral that is needed by the body system to work properly. It is a type of electrolyte. The human body needs potassium to build proteins, break down and use carbohydrates, build muscles,

maintain normal body growth, control the electrical activity of the heart, control the acid-base balance etc. The potassium content of *Moringa* leaves is said to be three times that contained in banana and as such can serve as a good food supplement to the body. The phosphorus concentration in the dried *Moringa* leaves increased by more than twice that available in the fresh leaves by the removal of moisture. The fresh leaves had a low concentration of 2.50mg/g. Freeze dried leaves had the highest value of 5.40mg/g and the sun dried had the least with a quantity of 3.56mg/g. The dried *Moringa* leaves had a higher value of phosphorus content than the fresh leaves, which is due to the removal of the moisture to avoid degradation of the leaves. The sun dried had the lowest value of phosphorus for the dried samples because of the heat added. Phosphorus is a mineral that makes up 1% of a humans' total body weight. It is present in every cell of the body. It is needed for the body to make protein for maintenance, growth, and repair of cells and tissues.

The iron content of the fresh *Moringa* leaves and the dried leaves using the 4 different drying methods varied from 5.174mg/L to 6.267mg/L. The fresh leaves had the lowest value of 5.174mg/L while the freeze-dried leaves had the highest value of 6.267mg/L. The oven dried, sun dried, and shade dried *Moringa* leaves had iron content value of 5.274mg/L, 5.333mg/L, and 6.167mg/L respectively. The same trend that was observed for the phosphorus content was also observed for the iron content of the *Moringa* leaves. It was observed that when the temperature used for dehydration is reduced, the iron content of the leaves increases. The human body needs iron to make the oxygen-carrying proteins haemoglobin and myoglobin. Haemoglobin is found in red blood cells and myoglobin is found in muscles. Magnesium content of the fresh *Moringa* leaves and the dried leaves ranged from 5.035mg/L to 5.385mg/L.

The fresh leaves had the lowest value of 5.035mg/L while the shade dried leaves had the highest value of 5.385mg/L. The freeze dried, oven dried, and sun dried *Moringa* leaves had magnesium content of 5.185mg/L, 5.345mg/L, and 5.275mg/L respectively. Magnesium is needed for more than 300 biochemical reactions in the body. It helps to maintain normal nerve and muscle function, supports a healthy immune system, keeps the heartbeat steady, and helps bones remain strong. It also helps regulate blood glucose levels and aid in the production of energy and protein. Calcium content of the fresh and dried *Moringa* leaves varied from 2.30% to 4.65% (Table 2). The fresh leaves had the lowest value of 2.30% while the freeze-dried leaves had the highest value of 4.65% followed by shade dried samples with 4.23%. The sun dried and oven dried samples had the least content, 3.95% and 3.20% respectively. The same trend that was observed in the phosphorus and iron content was also observed in the calcium content of the *Moringa* leaves i.e., freeze dried, shade dried, sun dried, oven dried. The calcium content of *Moringa oleifera* obtained in this study is within significant range with that reported by Moyo *et al.* (2011) of 3.65%. Calcium is one of the most important minerals required by the human body. Calcium helps form and maintains healthy teeth and bones. Proper levels of calcium over a lifetime can help prevent osteoporosis. *Moringa* leaves are said to contain four times the calcium of milk. This is an indication of the numerous nutrients available in the leaves

6. Conclusion

It can be concluded that drying generally retained the nutrient contents of *Moringa oleifera* leaves. There are no significant effects between the four treatments on the Nitrogen and Protein contents of *Moringa oleifera* leaves. Oven dried treatment have higher content of Fibre, while shade dried treatment has higher content of Protein, Phosphorus, Potassium and Sodium. It is therefore recommended that *Moringa oleifera* leaves should be dried using shade drying method due to the higher retention of some essential minerals.

References

- Anjorin, T.S., Ikokoh P., Okolo S. (2010). Mineral composition of *Moringa oleifera* leaves, pods and seeds from two regions in Abuja, Nigeria. *International Journal of Agric Biol.*, **12**: - 434.
- Anwar, F. and Bhanger, M.I. (2003). Analytical characterization of *Moringa oleifera* seed oil grown in temperate regions of Pakistan. *Journal of Agricultural and Food Chemistry* **51**:6558-6563.
- AOAC, 2006 Official methods of analysis of association of official analytical chemist international In. Horwitz, W.(Ed.), 18th Ed. AOAC press, Arlington VA, USA. Pp 19-2.
- Armelle, S. and Melanie, B. (2010): Growing and processing of *Moringa oleifera* leaves. *Moringa news/Moringa association of Ghana bulletin* pp 9-11.
- Babu, S C. (2000) Rural nutrition interventions with indigenous plant foods: a case study of vitamin deficiency in Malawi. International Food Policy Research Institute, Washington, DC. *Biotechnology, Agronomy Soc. Environ.* **4**(3): 169-179.
- Dahot, M.U. and Memon, A.R. (1987). Properties of *Moringa oleifera* seed lipase. *Pakistan Journal of Scientific and Industrial Research* **30**(11):832-835.
- FAO, (2001). *Country Pasture/Forage Resource profiles: Philippines*. Pp.10-15.
- Francis, J. K. and Liogier, H.A. (1991). *Naturalized exotic tree species in Puerto Rico. Gen. Tech. Rep.* S0-82. New Orleans, LA: U.S. Department of Agriculture, Forest Service, Southern Forest Experiment Station. pp12.
- Fuglie TA., Lowell J. (2001). The Miracle Tree: *Moringa oleifera*: Natural Nutrition for the Tropics. *Training Manual*. Church World Service, Dakar. Senegal. Pp 17.
- Gardener, N. and Ellen, J. (2002). *Moringa* tree has many uses, from food to firewood. Yumasun. *Portal market, Moringa Tree Powder*. PP.55
- Gidamis, B.A., Panga J.T., Sarwatt S.V., Chove B.E., Shayo N.B. (2003). Nutrients and anti-nutrients in raw and cooked leaves and mature pods of *Moringa oleifera* Lam. *Ecol. Food Nutr.*, **42**:399-411.
- Hassan, S.W., Umar, R.A., Maishanu, H.M., Matazu, I.K., Faruk, U.Z. and Sani, A.A. (2007). The Effect of Drying Method on the Biochemistry **2**(5):349-353.
- HDRA, (2002). The organic organization. *Moringa oleifera* A multipurpose tree. Coventry; 2002
- Hsu R. (2006). *Moringa oleifera medicinal and Economic uses international course on Economic botany*, National Herbarium, Leiden the Netherlands: 3488-3491.

- Idohoz-Dossou, D., Diouf, N.A., Gueye, Al., Guino, AT. and Wade, S. (2011). "Impact of darily consumption of moringa (*moringa oleifera*) day leaf powder on iron status of sengalese lactating women *African Journal of food, Agriculture, Nutrition and Development*: 4985-4999.
- KhaIafalla, E., Dafata H.M., Nasaratab, A.A., Abou H., Tnein K.M., Lightfoot D.A., El-Deeb F.E., El-Shemy H.A. (2010). Active principle from *Moringa oleifera* Lam Leaves effective against Iwo eukerriias and a hepatocarcinoma. *African Journal of Biotechnoogy*.**9**(49):8467.8471.
- Khawaja, T.M., Tahir, M. and Ikram V.I.H. (2010). *Morniga oleiferai* a natural gift-A review. *Pharumsci. And Res.***2**(11); 775-781.
- Ladan, M.J., Abubakar, M.G., Lawal, M. (1997). Effect of solar drying on the nutrient composition of tomatoes. *Nig. J. Renew Energy*,**5**:67-69.
- Lisa, L.P. (1997). Wild plant food in agricultural environment: A study of occurrence, management and gathering rights in North East Thailand. *Human Organization*, **56**: 209-221.
- Makkar, H.P.S. and Beeker, K. (1996). Nutrients and antiquality factors in different morphological parts of the moringa oleifera tree". *Journal of Agricultural science* :311-322.
- Morris, A., Barnett, A. and Burrows, O. (2004). Effect of processing on nutrient content of foods.Cajarticles,**37**:160-164.
- Moyo, B., Masika P.J., Hugo A., and Muchenje V., (2011): Nutritional Characterization of *Moringa Oleifera*. *African Journal of Biotechnology* **10**(60): 12925 12933.
- Nouala, F.S., Akinbamijo, O.O., Adewum, A., Hoffman, E., Muetzel, S., Becker, K. (2006). The influence of *Moringa oleifera* leaves as substitute to conventional concentrate on the *in vitro* gas production and digestibility of groundnut hay. *Livest Res. Rural Dev.* **18**:25-32.
- Onimawo, Al., (2001). *Nutrition for the vulnerable group*. Ambik press Ltd. Benin city.pp 5-10.
- OSCN, (2004). 5th Report on the World Nutrition situation: Nutrition outcomes. United Nations Systems/standing committee in nutrition, Geneva.
- Pallavi, J. and Dipika, M. (2010). Effect of dehydration on the native value of drumstick leaves. *Journal of Metabolomics and Systems Biology.* **1**(1), Pp. 5-9.
- Reyes, S.N., Sporndly E. and Ledin I. (2006). Effect of feeding different levels of foliage from *Moringa oleifera* to creole dairy cows on intake, digestibility, milk production and composition*Livest.Sci.*,**101**(1-3):24-31.
- Rodrigues, A.S., Perez-Gregorio, M.R. Garcia-Falcon, M.S., SimalGandara, J., Almeida, D.P.F. (2011). Effect of meteorological conditions on antioxidant flavonoids in Portuguese cultivars of white and red onions. *Food Chemistry*, **124**(1):303-308.
- Singh, B.R. and Babaji, M.A. (1990). Characteristics of soils in Dundaye District 2:The Fadama Soil of University Farm. *Nigerian Journal of Basic and Applied Sciences*, **4**:29-39.