

An Evaluation of the Potentials of *Moringa oleifera* Lam), A Vegetable and Hedgerow Plant for Diet Supplements and Multipurpose Utilizations

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Abstract

A survey was carried out to evaluate the potentials of *Moringa oleifera* (Lam) within and outside the Kano metropolis of Kano state, Nigeria, where it serves as vegetable and hedgerow plant for diet supplements and multipurpose utilizations. Structured interview was used with a total of 100 respondents, randomly spread. In the Kano metropolis, which falls within the Kano city, 4 Local Government Areas (LGAs) were covered. These are: Nassarawa, Ungogo, Tarauni and Dala; while Madobi, Minjiibir, Garun Mallam and Dambatta LGAs were covered outside the Kano metropolis. Results of the structured interview using the Convenience Sampling Technique revealed that *Moringa* is very rich nutritionally, economically and medicinally. *Moringa* utilization cuts across various categories of people with 69% usage recorded for male and 40% for literate users, while students and civil servants had 21% each. *Moringa* farmers that cultivates simultaneously on farmlands and backyard gardens were however 73%. Analysis of results further indicated that the plant is rated very high as diet supplements in the state, owing to the fact that it is very rich nutritionally, apart from its economic and medicinal values. It is however recommended that its nursery propagation be encouraged, and community interest in its cultivation mobilized.

Keywords: survey, moringa, supplements, hedgerow, vegetable

1. Introduction

Multiplicity of products is derivable from the forests. Apart from wood products, forest also provides a wide range of non-timber forest products which are well known and utilized by rural and urban dwellers. More so, plants are created by God for man's use, and every plants thus created is to serve a purpose (Adebayo, *et al*, 2004). Studies had shown that Nigeria and in fact the tropical world is endowed with abundant forest lands, rich in valuable plants and raw materials (Soladoye, *et al*, 1993), the biological products which the world's poor depends on to as much as 90% for their needs in terms of food, fuel, medicine, shelter and transportation (Vernooy, 2003). Prominent among these is *Moringa oleifera* (Lam), which has very high nutrition, medicinal and other economic values (Madukwe, 2013).

Moringa oleifera is a small tree with sparse foliage, often planted in compounds and farmlands (Keay, 1989). It belongs to the genus of the tropical flowering plant family Moringaceae, containing many diverse species and accessions. Among the different species, only *Moringa oleifera* L., is cultivated (Shahzad, *et al.*, 2013). *M. oleifera* fruit is a legume, the tree is also known as bean tree, drumstick tree or horseradish tree among its many names (GRIN, 2017). It is used as strip plants and life fencing in northern Nigeria, but found almost everywhere in the country (Umar, 2007). The genus *Moringa* has about 13 species and it is native to northern India from where it spread to the tropics and sub-tropical regions of Asia, Africa, and Latin America; gaining significant grounds throughout the world for its nutritional, medicinal, and industrial values as reported by Muhamman (2008).

M. oleifera is a fast growing, but deciduous and perennial tree that grows to a height of up to 8 m, and 60 cm in girth, with a crooked bole often forked from near the base. It has a smooth, dark grey bark and thin yellowish slash (Keay, 1989). The leaves are feathery, pale green, compound, tripinnate, 30-60 cm long with many small

leaflets, 1.3-2 cm long and 0.3-0.6 cm wide (Muhamman, 2008). Lateral leaves are elliptic, while terminal ones are obovate and slightly larger; flowers are fragrant, white or creamy-white, about 2.5 cm in diameter, borne in sprays with 5 at the top of the flower, stamens yellow, pods pendulous, brown, triangular, splitting length wise into 3 parts when dry, 30-120 cm long, 1.8 cm wide; and containing about 20 seeds embedded in the pith, with pod tapering at both ends and 9-ribbed. Seeds are dark brown with 3 papery wings and the main root usually thick (Muhamman, 2008).

The moringa tree prefers light to sandy soils and cannot perform on heavy clayed or water logged, but thrives as well on poor soils. It is propagated vegetatively through cuttings or by seeds sown in the nursery, or rather by direct seeding in the field. As the tree grows, the more it is cut back, the more leaves it will produce (Hirt and M'pia, 2001). The tree can be grown in an alley cropped farm or intercropped with cereals, legumes; etc. Seeds germinate in 15 days, and could be transplanted into the field at 90 cm height. When propagation is through cuttings, 45 cm to 1.5 m long cuttings are taken from healthy branches with hard wood, which are kept under shade for 3 days to lose moisture; and further planted directly into the field, or into nursery polypots (Bwama, 2006).

Moringa leaves are consumed locally especially in northern Nigeria as vegetables and local salad; it is also widely used as fodder for livestock. Moringa has been described as the most reliable vegetable and fodder because of its high nutritional value (Iqbal and Bhangar, 2006; Umar, 2007; Leone, *et al*, 2015). The leaves which could be eaten fresh or dried, are especially good for children aged 1-3 years, as one table spoonful (8 g) of leaf powder has about 14% protein, 40% calcium, 23% iron and (almost all the) vitamins A and C. Six spoonfuls of the leaf powder would also satisfy nearly all of a woman's daily Iron and Calcium needs during pregnancy and breast feeding, while the cake is also a good source of animal feeds (Martin, 2000). Further reports from Fluglie (2000) expressed the nutritional value of moringa leaves, leaf powder, and pods per 100 g of edible portion (Table 1). The comparative nutritional quality of the plant species is contained in Figure 1. Apart from the high nutritional values of the plant parts; the seed also contain a cationic polyelectrolyte that has proved efficient in water treatment as a substitute to Aluminum sulphate and other flocculents (Muhamman, 2008). There are no chemical reactions when used in water treatments, as the plant seeds contain no harmful chemicals or pollutants against human health but are biodegradable.

The plant species also have very high medicinal values through its leaf, stem, root, liquid extract, etc. (Olson and Carlquist, 2001; Atawodi, *et al*, 2010). Moringa is especially useful in stabilizing of people with HIV/AIDS. It is also reported to cure gonorrhea, ulcers, itching, and eye irritation among others (Muhammad, 2008). Furthermore, several local and industrial products are derivable from its various parts such as leaves, roots, bark, etc. (Table 2).

Owing to these diverse economic values of the plant species therefore, it deemed necessary to explore plants potentials for further analysis and evaluation because it is widely available across the Nigerian ecological zones. This study therefore attempts to establish the propagation of *M. oleifera* as a supplementary vegetable crop and hedgerow plant in homestead gardens, orchards and farmlands; as well as explore its utilization potentials for nutrition, medicinal and other economic purposes in Kano state of Nigeria, in view of its high valued resources capable of alleviating poverty and improving the living standards of the citizenry.

Table 1. Nutritional value of leaves, leaf powder, and pods of Moringa per 100 g of edible portion

	Pods	Leaves	Leaf powder
Moisture (%)	86.9	75.0	7.5
Calories	26	92	205
Protein	2.5	6.7	27.1
Fat (g)	0.1	1.7	2.3
Carbohydrate	3.7	13.4	38.2
Fiber (g)	4.8	0.9	19.2
Minerals (g)	2.0	2.3	-
Cs (mg)	30	440	2,003
Mg (mg)	24	24	368
P (mg)	110	70	204
K (mg)	256	256	1,324
Cu (mg)	3.1	1.1	0.57
Fe (mg)	5.3	7	28.2
S (mg)	137	137	870
Oxalic acid (mg)	10	101	1.6
Vitamin A-B carotene (mg)	0.11	6.8	16.3
Vitamin B-choline (mg)	423	423	-
Vitamin B1-thiamin (mg)	0.05	0.21	2.64
Vitamin B2-riboflavin (mg)	0.07	0.05	20.5
Vitamin B3-nicotinic acid (mg)	0.2	0.8	8.2
Vitamin C-ascorbic acid (mg)	120	220	17.3
Vitamin E-tocopherol acetate (mg)	-	-	133
Arginine (g/16g N)	3.6	6.0	1.33
Histidine (g/16g N)	1.1	2.1	0.61
Lysine (g/16g N)	1.5	4.3	1.32
Tryptophan (g/16g N)	0.8	1.9	0.43
Phenylalanine (g/16g N)	4.3	6.4	1.39
Methionine (g/16g N)	1.4	2.0	0.35
Threonine (g/16g N)	3.9	4.9	1.19
Leucine (g/16g N)	6.5	9.3	1.95
Isoleucine (g/16g N)	4.4	6.3	0.83
Valine (g/16g N)	5.4	7.1	1.06

Source: Fluglie (2000)

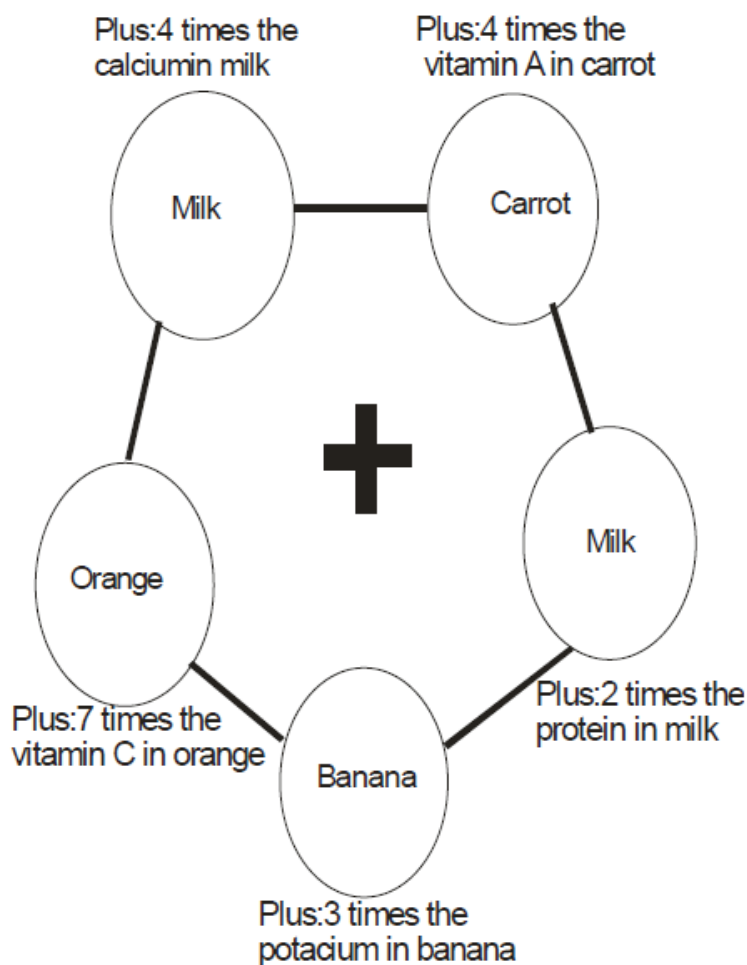


Figure 1. Comparative nutritional quality of *Moringa oleifera*

Source: Muhamman (2008).

Table 2. Moringa plant parts and their derivatives

Plants Part	Derivable local and industrial Products
Leaves	- Fresh in bunch to the market.
	- Dried in jute bags to the market
	- Export as fodder
Bark	- Powdered in container for medicinal uses.
	- Treated to obtain fibres for weaving industries
	- Mat, basket and bag production
Seeds	- Rug/ carpet production
	- Raw in bags for exports
	- Fried in paper bags for domestic consumption
	- Canned like green peas for local and international market
Oil	- Milled and prepared into cakes for water purification
	- Grits for animal feed formulation
	- Cosmetics
Roots(horse radish)	- Table or cooking oil
	- Fresh for local market
	- Shred and confined in jar (super market)
	- Dried and powdered for medicinal uses

Source: Umar (2007)

1.1 The Study Area

Kano state is one of the largest Hausa states in Nigeria. It is located in the north-west geo political zone, with current population estimate of over 9 million people (Salami, 2014). Kano State occupies a land mass of about 20,131 Km², on an approximate latitude 11.76° N, and longitude 8.66° E, (Abdulkadir, *et al*, 2013). Rainfall is between May and October, but stable for about 4 months between June and September, approximately 510-1140 mm. per annum. Relative humidity is low and temperature varies between 14°C and 38°C, typical of Sudan savannah ecosystem (Salami 2003).

2. Methods

The survey was carried out within and outside the Kano metropolis. Structured interview was used with a total of 100 respondents, 50 each from within and outside the metropolis, spreading across the two areas randomly, and using the Availability Sampling Technique. Availability sampling is the same as accidental or convenience sampling. It is mostly used in the interview research method, and involves a situation where anyone seen or come across is interviewed (Asika, 2006). A total of 4 Local Government Areas (LGAs) were covered for each of the 2 sampling units, amounting to 8 LGAs in all. These were Nassarawa, Ungogo, Tarauni and Dala in the Kano metropolis; while Madobi, Minjiibir, Garun Mallam and Dambatta LGAs were covered outside the metropolitan, (Figure 2). Sampling frame were however drawn simultaneously, working across the dwelling features inclusive of sex, marital status, farmers group, occupation and age distribution checklists.

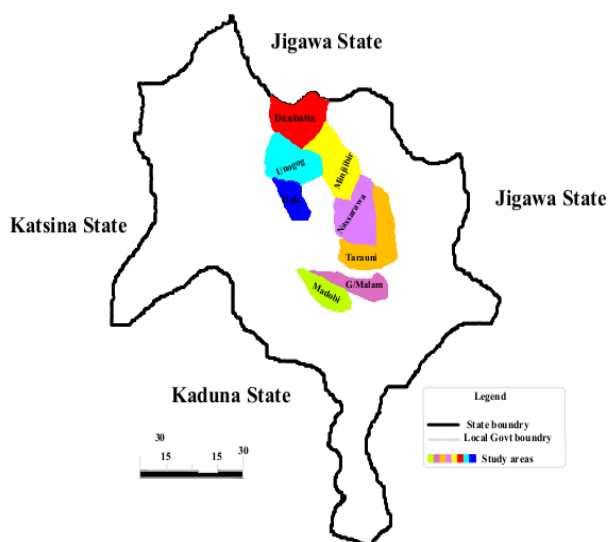


Figure 2. Map of Kano State showing study areas

3. Results and Discussion

Results of the structured interview indicated that *M. oleifera* is highly cultivated in homestead gardens and farmlands in Kano State, serving as vegetables for diet supplements, and for other socio-economic utilizations. The Accidental Sampling Technique with 100 respondents interviewed therefore indicated that 69 percent were male, while 31 percent were female. The males' farm plots were larger and covered more productive grounds than that of the females. This attributes may not be unconnected with the facts that males are stronger than the females, and gives higher output, especially when the productive imputes has to do with application of physical strength in cultivation terms. Additionally, it is peculiar of men in African context featuring as bread winners, and as such liable to higher productive capacity in lieu of their expected responsibilities.

The marital status of respondents was 60, 30, and 10 percents to the married, the singles, and the divorced respectively. Also, within 21-30 and 31-40 age distribution were the highest moringa users for nutrition, medicine and other socio-economic purposes, having 31 and 37 percents respectively; while age intervals of 41-50, 51-60, and 61-70 had 20, 7, and 5 percents respectively, also in the utilization quantum. The high disparity within the users between age 21- 40 and that of 41-70 may be due to the fact that the former were still in the developing age class, and consumes more diet supplements such like that of the moringa for growth and development, unlike the latter that were at the diminishing age class. More so, taste values for high consumption rate is lower with the aged, in comparism to the developing age class, which connotes the difference in the

recorded consumption patterns.

Further to the above, a record of 15 and 12 percents were taken during the inventory for moringa cultivators at homestead gardens and farmlands respectively; while respondent cultivators that operates both the farmlands and backyard farming activities were 73 percent. The high rate of cultivation of the plant species at both available regimens instituted within the farmlands and homestead gardens confirm the high rating spectrum of the plant species as vegetables for diet supplements. This instance is supported in Fluglie (2000); Umar (2007); Muhamman (2008); Madukwe (2013); Shahzad, *et al.*, (2013) and Leone, *et al.*, (2015) reports which specified that moringa plant is commonly cultivated as supplementary hedgerows in farmlands and backyard gardens as vegetables for domestic utilization in diet supplements and immediate cash appendages. Additionally, the unemployed recorded 33 percent, while the traders had 25 percent, but the civil servants and students 21 percent each. The educated respondents were 40 percent, while the uneducated, the urban and rural dwellers were 6, 35 and 19 percents respectively as moringa cultivating community, indicating the inclusiveness of all and sundry in the plants cultivation, (Table 3).

Table 3. Socio-economic characteristics of respondents on the use of *Moringa oleifera*

Variables	Frequency	Percentage
SEX		
Male	69	69
Female	31	31
Total	100	100
MARITA STATUS		
Married	60	60
Single	30	30
Divorced	10	10
Total	100	100
MORINGA CULTIVATION		
Homestead gardens	15	15
Farmlands	12	12
Homestead gardens and Farmlands	73	73
Total	100	100
OCCUPATION		
Students	21	21
Civil servants	21	21
Traders	25	25
Unemployed	33	33
Total	100	100
CATEGORY OF USERS		
Rural dwellers	19	19
Urban dwellers	35	35
Educated	40	40
Uneducated	6	6
Total	100	100

Enumeration exercise also further revealed as testified across all the respondent levels that sales of the condiment prepared from Moringa creates employment, and as well generates income at both rural and urban levels, which also alleviate poverty with high potentials for exports. This is also supported in Umar (2007) and Muhamman (2008) reports. Analysis from respondents between the age classes of 31-70 also reiterated emphatically that extract from Moringa leaves is good for erection in men, as well as the treatment of piles, apart from the medicinal values of its root and stem, as concurred in Atawodi, *et al.*, (2010) analysis. Tender green pods are also said to cure back ache, and that eating the leaves prevents skin diseases according to these old generation respondents in lieu of experience, which is also in agreement with Umar (2007) and Muhammad (2008) revelations. The various parts of the plants used for medicinal purposes as obtained in the enumeration process are presented in Table 4.

Further to the above, the leaves are cooked and used like spinach, and are commonly dried and crushed into

powder for soups and sauces as revealed by unanimous testimonies across all categories of respondents. This is also corroborated in the analysis of Olson and Carlquist (2001), which analyzed that some of the calcium in moringa leaves is bound as crystals of calcium oxalate at levels 1/25th to 1/45th of that found in spinach, thus encouraged its consumption in supportive concordance.

Going by all of these results from the enumeration exercise therefore, it would be seen that moringa utilization cuts across all ages, gender, and discipline. This may not be unconnected with the fact that zogole (moringa) condiment is a staple food supplement within the Hausa community of Kano State, principally because of the high medicinal and nutritional composition of the plant species, as well as its associated economic values as contained in Umar (2007); Atawodi, *et al.*, (2010) analysis.

4. Conclusion

Moringa oleifera is a staple food material incorporated into an average meal as a vegetable or condiments. It is highly acceptable among the Hausa communities in Kano State of Nigeria. However, the plant species could not be found in plantation, but as an intercrop, fence, or garden plant despite its abundant socio-economic and medicinal benefits. However, very important to note is the fact that cultivation and utilization of the plant species cuts across all ages and categories of human endeavours, including students and the aged. This cultural participation in the cultivation and utilization philosophy of the plant inclined moreover to conclude with the fact that *M. oleifera* is a renowned life support tree species which has vibrant socio-economic and medicinal values which is not limited to the fabrics of the Hausa community of Kano State, Nigeria alone, but abounds far and wide beyond limited scope.

Table 4. Moringaplantparts and their medicinal usesas obtained in Kano state

Plant parts	Ailments	Formulation/Administration
Leaves	Gonorrhea	Antibiotics
	Body itching	Anti histamine
	Eye irritation	Drops
	Renal failure	Diuretic
	Asthma and bronchitis	Cardiac and circulatory tonic
	High blood pressure	Anti hypertensive
	Low libido	Stimulant
	Pile	Purgatives, Laxatives, Antibiotics
	Skin diseases	Antibiotics, Disinfectants
	Malnutrition	Diet supplements
	Diarrhea and vomiting	Dehydration therapy
	Anemia	Hematinic
	Ulcers	Antacid
	Wounds and cuts	Antibiotics
Bark	Loss of appetite, malnutrition	Diet supplement, Warm expellant
	Corneal nebulae, ear diseases	Drops
	Fever	Antifebrile
	Mouth sore, leprosy	Antiscorbutic
	Vitamin C deficiency	Antiscorbutic
	Diarrhea	Dehydration therapy
Pods and Seeds	Back ache	Analgesic
	Pile	Antibiotics, Laxatives
Roots	Malnutrition	Diet supplements
	Skin infection	Ointment
	Epilepsy, nervous debility	Stimulant
	Asthma and bronchitis	Cardiac and circulatory tonic
	Hysteria, stress and anemia	Stimulants, Hematinic
	Renal failure	Diuretic
	Inflamations	Anti inflammations
	Pile (hemorrhoids)	Antibiotics, Stimulants
	Loss of appetite	Worm expellant, Diet supplements
Ulcers	Antacids	

Recommendations

By virtue of its preference in the community as evidenced through its relative availability and usage, there is a need to canvass for its conservation and large scale cultivation, probably by incorporating it into our farming systems notably as an agroforestry variant, in crop rotation, organic farming, etc. Moreover, in view of the world's food and water crisis therefore, and the level of poverty prevalent in the developing countries including Nigeria, the use of local resources like moringa has become pertinent to reduce gross dependency on imported goods, so as to improve the economy and tastes of the people. Efforts should further be directed towards its acceptance by the food processing and pharmaceutical industries as raw materials for abundant potential products that could be manufactured from the plant parts. This could be realized via financial assistance to small scale industrialists for industrial proliferation and commercialization purposes.

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