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Assessment of Medicinal Benefits of Moringa oleifera and its Influence on the Health Outcomes of Poor Communities in Zaria, Nigeria

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Abstract

Issues: People in different regions of the world have been using *Moringa oleifera* (Lam) for the treatment of various disorders such as headaches, febrile illness, inflammation, gastrointestinal ailments, heart disease, asthma, and rheumatism. This plant is also used for nutritional benefits as well as to prevent diseases.

Objective: This study aims to determine the medicinal benefits of *Moringa oleifera* and its influence on the health outcomes amongst poor communities in Zaria, Nigeria. The study assessed the current understanding of this topic because of its significance on the health of populations in different regions of the world.

Study Design: A cross-sectional survey was conducted to measure multiple factors to identify the medicinal benefits of *Moringa oleifera* and its influence on the health outcomes amongst poor communities in Zaria North-West Nigeria.

Principal Findings: Most people (99.3%) in the community use *M. oleifera* and they have reported medicinal benefits in a variety of health conditions (cough, fever, hypertension, diabetes mellitus, arthritis, headache, abdominal problems, health promotion, hunger and nutrition). The commonest experience of medicinal benefit (24.9%) and the best outcome in using *M. oleifera* (45.5%) were reported in the treatment of hypertension. The results have also shown that all individuals that consume *Moringa oleifera* plant have improved health outcome.

Conclusion: *Moringa oleifera* is being used for a variety of medical benefits and have positive influence on the health outcomes of the poor communities in Zaria, Nigeria.

Keywords: *Health Outcomes; Nutritional Benefits; Medicinal Benefits; Moringa*

Introduction

Moringa oleifera (Lam), popularly known as "*Zogale"* in Hausa language (West Africa), drumstick and horseradish tree in some other parts of the world is a plant species that is indigenous to Northern India but is now found in the tropical and subtropical regions of the world [3,10,16,24]. The plant is currently grown in Africa, Europe, Americas and Asia. The high nutritional and medicinal value of the plant *M. oleifera* has been reported by scholars [3,10,16,24]. Scientific studies have confirmed the claims of the nutritional and medicinal contents of the morphological parts of *M. oleifera.* This plant is a rich source of protein, minerals and vitamins as well as has pharma-

cological and biotechnological potentials [3]. It has been used for the treatment of various disorders such as headaches, febrile illness, inflammation, gastrointestinal ailments, heart disease, asthma, and rheumatism [3]. Some of the pharmacological properties of *Moringa oleifera* include analgesic, anti-inflammatory, diuretic, antihypertensive, antioxidant and anti-tumor activities. One of the qualities of *M. oleifera* is that every part of the plant has some nutritional and medicinal benefits [3].

Aim of the Study

This study aims to determine the medicinal benefits of *Moringa oleifera* and its influence on the health outcomes amongst poor communities in Zaria, Nigeria. The study assessed the current understanding of this topic because of its significance on the health of populations in different regions of the world. The research questions were, "what are the medicinal benefits of *Moringa oleifera*, and what is the effect of *Moringa oleifera* on the health of communities in Zaria, Nigeria?"

Literature Review

Medicinal plants have been used by humans to prevent and treat diseases due to their pharmacological and nutritional properties. *Moringa oleifera* (Lam) has stood out amongst the medicinal plants that have been studied by scientists because of its benefits in the treatment of many types of diseases [3,18].

Phytochemical properties

The potentials of *Moringa oleifera* as a medicinal plant has been linked to the availability of some compounds within *M. oleifera* plant as secondary metabolites and these include, alkaloids, tannins, flavonoids, steroids, saponins, coumarins, quinines and resins [3]. An assessment of the chemical constituent of an extract from *M. oleifera* leaves, flowers, pods, stems and seeds have confirmed the presence of secondary metabolites such as phenolic acids, gallic acid, ellagic acid, chlorogenic acid, ferulic acid, glucosinolates, flavonoids, quercetin, vanillin and kaempferol [3]. These secondary metabolites have been demonstrated to have nutritional and pharmaceutical properties as well as health benefits [3,18].

Phytochemical screening of *M. oleifera* in a study conducted in Sokoto, Northern Nigeria, Idris and Adamu (2018) [16] demonstrated the presence of saponins, tannins, alkaloids, flavonoids, anthraquinones, glycosides and steroids in the leaves. Similar findings have also been reported by other scholars earlier [8,17]. The presence of different primary and secondary metabolites synthesized by this plant has been shown to be the reason for some of the biological effects of the plant such as treatment of parasitic infections, treatment of diarrhea, effects against bacterial infections, antioxidant properties and a lot more [16]. Polyphenolic compounds have been detected in many plants including *M. oleifera* extracts which were shown to be responsible for the anti-inflammatory, antihypertensive, anti-diabetic and anti-oxidant effects [1-3,16,18,20].

Anthraquinones are metabolites in *M. oleifera* which were shown to improve problems related to digestion while Tannins, on the other hand, are polymeric phenolic compounds that have shown effects against infectious agents, have anti-carcer and antimutagenic effects [3,16,18]. Scholars have also reported the anti-cancer effects of *M oleifera* may have come from the steroids found in the leaves of the plant [16]. *M. oleifera* leaves also contain glycosides and alkaloids which are responsible for its effects against hypertension and analgesic anti-inflammation respectively [7,9,16].

Alkaloids have been known to have analgesic and anti-inflammatory effects [7,16]. Tannins were described to have antimicrobial, anticarcinogenic and antimutagenic properties [16]. Saponins play key role in the fight against microbes such as fungi, bacteria and viruses as well as possess other pharmacological effects [5]. Flavonoids have been shown to have anti-inflammatory, antioxidant, antidiabetic and antihypertensive effects [1,16,20].

Nutritional properties

M. oleifera provides high value nutritional contents from its leaves, flowers, pods as well as its seeds and this is why some international organizations have advocated for its use as a source of food especially in poor communities [3,18]. Studies have reported that there are more than ninety nutritional compounds contained in *M. oleifera* which include protein, lipids, carbohydrates and fibers [3,22]. It is a source of nutrition to children and infants in the tropics that is often use to treat malnutrition. The most abundant nutrient in *M. oleifera* is protein and so far 19 different amino acids have been identified in association with the plant. Vitamins and minerals also form part of the nutrients provided by *M. oleifera* and so are stearic acid as well as palmitic acid and oleic acid which are available in the seeds of the plant. However, the leaves of *M. oleifera* also contain linolenic acid and palmitic acid [3].

Health benefits

Evidence from scientific studies has shown that the leaves of *M. oleifera* have hepato and renal-protective activities especially against drugs like gentamicin, rifampicin, pyrazinamide, isoniazide and acetaminophen [3,24,27,30]. It has been observed in studies involving the treatment of animals with *M. oleifera* leaf extract that the serum levels of liver enzymes as well as urea and creatinine were reduced. A histological examination of the liver and kidneys of these animals that have drug-induced hepatic and renal injuries has confirmed a decrease in the specific organs damage after treatment with leaves of *M. oleifera* [3,24,30].

Another potential benefit of *M. oleifera* leaves is its ability to reduce serum cholesterol and low-density lipoproteins in animals [3,18]. Also, some scholars have suggested that the plant may have an anti-obesity potential by demonstrating its body lipid lowering effects in animals [18]. However, more studies are required in humans to confirm these effects. A study of diabetic patients who were treated daily with 8g of *M. oleifera* leaf powder for 40 days showed a reduction of serum glucose level [3,19]. Other potential benefits of *M. oleifera* reported earlier include anti-cancer, anti-inflammatory, anti-oxidant, neuro-protective, antimicrobial effects and immune system enhancement [3,6,14,18].

Methodology

Study area

The study area was Zaria local government created in 1976, making it one of the oldest local government areas among the 23 in Kaduna State. It is situated in the northern part of the State and shares boundaries with Sabon-Gari L.G.A to the north, Igabi L.G.A to the south, Giwa L.G.A to the west and Soba L.G.A to the east. The area has a total population of 264,045. The most predominant tribe is Hausa and majority practice Islam as their religion. Main occupations are farming, trading, and civil service. The L.G.A has 13 political wards which are Anguwan-Fatika, Anguwan-Juma, Dambo, Dutsen-Abba, Gyallesu, kaura, kwarbai-A, kwarbai-B, Limancin-kona, Tudun-wada, Tukur-Tukur, Kufena, and Wuchichiri. There are 35 health posts and primary health centers, and one general hospital.

Study design

Cross-sectional descriptive study design was used.

Study population

The study population includes all the head of households or their representatives in the study area.

Inclusion criteria

1. Adult members of the community.
2. Adult members of the community living in the study area.

Exclusion criteria

1. Adult members of the community not present during the data collection.
2. Adult members of the community who refused to give their consent.

Sample size determination

The sample size was determined using the following formula:

$$n = \frac{Z^2pq}{d^2}$$

Where:

n = Minimum sample size

z = Standard normal deviate which corresponds to 95% confidence interval level

p = Proportion of the target population estimated to have used *Moringa* plant = 50% = 0.50

q = 1 - 0.50 = 0.50

d = Degree of precision = 5% = 0.05

$$n = \frac{(1.96)^2 \times 0.50 \times 0.50}{(0.05)^2} = \frac{0.9604}{0.0025} = 384.16$$

n = 384

Adding 10% non-response rate to the minimum sample size = 384 + 38.4 = 422.4

Hence, the final minimum sample size is 422.

Sampling technique

A multi-stage sampling technique was used to obtain the sample:

- **Stage 1 (LGA selection):** From the list of all the twenty-three (23) LGAs in Kaduna state, one LGA was selected randomly using balloting and this happen to be Zaria LGA.
- **Stage 2 (Ward selection):** All the wards under Zaria LGA were listed, and from the list, one ward (Tukur-Tukur ward) was selected using simple random sampling by balloting.
- **Stage 3 (Settlement selection):** All the settlements under Tukur-Tukur ward were listed and the main Tukur-Tukur town was randomly selected from the list of all the settlements in the ward via balloting also.
- **Stage 4 (Household and participants selection):** House numbering and household listing was conducted in Tukur-Tukur, and from the list of all the households in the settlement, a sampling frame containing the names of all eligible respondents i.e. all adult

men and women, was obtained. Using systematic random sampling technique, a representative sample of 422 adults was obtained.

Data collection tool

A pre-tested, structured interviewer administered questionnaire was used to collect the data from 422 adults in the study area. The questionnaires covered four topics: (i) knowledge and attitude of individuals and groups about the role of *Moringa oleifera* in health outcome of people in the community; (ii) health outcome and nutritional status after consumption of *Moringa oleifera*; and (iii) individual experiences of the role of *Moringa oleifera* on health improvement. The data collection was conducted by the researcher and five trained research assistants. The researcher supervised the overall data collection process, and checked the filled questionnaires for consistency and completeness at the end of each day's work during data collection. Prior to data collection, the questionnaire was prepared in English language and translated to Hausa language/local language and back-translated to English for consistency of the data that was obtained. Training was conducted for the research assistants/data collectors for 3 hours per day over a period of two days prior to the commencement of the study. After the data collection, questionnaires were reviewed and checked again for completeness and relevance by the researcher.

Data processing and analysis

Collected data was entered into a computer, validated and analyzed using statistical package for social sciences (SPSS) software version 20.0. For the descriptive aspect of the analysis, frequency distributions were generated for all categorical variables. Means and standard deviations and other descriptive measures were determined for quantitative variables. Chi Square Test and Fisher's Exact Test was applied for the comparison of proportions and for evaluating associations of categorical variables in contingency tables. Statistical significance was said to be achieved where P-value equals or is less than 0.05.

Results

Socio-demographic characteristics of the study population

A total of 422 individuals participated in the study (this gave a 100% acceptance rate) of which 420 (99.5%) were males and 2 (0.5%)

S/no.	Socio-demographic characteristic		Frequency	Percent (%)
	Characteristic	Variable		
1.	Gender	Female	2	0.5
		Male	420	99.5
2.	Age (years)	15 - 24	1	0.2
		25 - 34	57	13.6
		35 - 44	116	27.5
		45 - 54	173	41.0
		55 - 64	66	15.6
		65 and above	9	2.1
3.	Occupation	Civil servant	120	28.4
		Business owner	149	35.3
		Unemployed	13	3.1
		Others	140	33.2
4.	Marital status	Single	1	0.2
		Married	420	99.5
		Widowed	1	0.2

Table 1: *Socio-demographic characteristics of the respondents (n = 422).*

females. The median age of the participants was 48 years and the participants are mostly business owners followed closely by farmers (Others, as seen in table 1). Table 1 describes the participants by gender, age, occupation and marital status.

Medicinal benefits of *Moringa oleifera*

The percentage of participants who reported that they have been using *M. oleifera* was high in this population (99.3%). The most common medicinal benefit for using *M. oleifera* was to improve the symptoms of hypertension (80% of respondents). Respondents have also been taking *M. oleifera* to treat cough, fever, diabetes mellitus, arthritis, abdominal problems as well as headache. However, other reasons for using *M. oleifera* as indicated by respondents include health promotion, hunger and for nutritional benefits. The best outcome for using *M. oleifera* to improve health was seen in individuals with hypertension (45.5%). Dosages given for these indications were not specific to a particular condition and most individuals (49.3%) decided the dose they want to take by themselves. The dose of *M. oleifera was* taken

Health conditions improved with Moringa	Frequency	Percent (%)
Cold/Cough	43	10.2
Fever	46	10.9
Hypertension	105	24.9
Diabetes mellitus	41	9.7
Arthritis	9	2.1
Headache/Migraine	14	3.3
Abdominal problems	14	3.3
Others (specify)	150	35.5
Total	422	100.0

Table 2: *Uses of M. oleifera for medicinal benefits.*

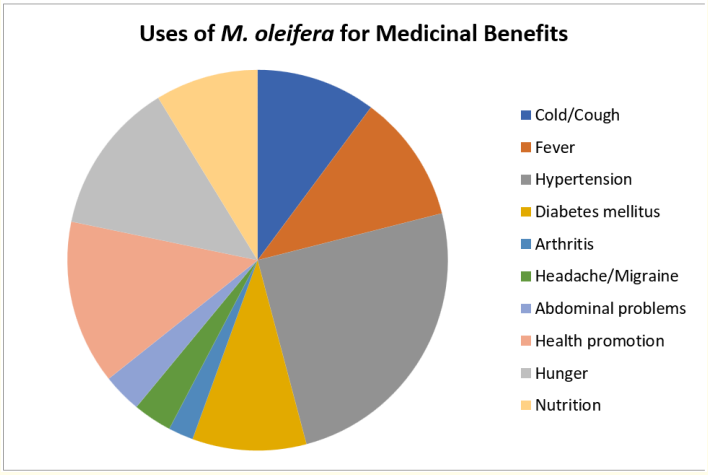

Figure 1: *Uses of M. oleifera for medicinal benefits.*

Best outcome for using *M. oleifera*	Frequency	Percent (%)
Cold/Cough	26	6.2
Fever	42	10.0
Hypertension	192	45.5
Diabetes mellitus	42	10.0
Arthritis	9	2.1
Headache/Migraine	9	2.1
Abdominal problems	13	3.1
Others	89	21.1
Total	422	100.0

Table 3: *Best outcome in using M. oleifera for medicinal benefits.*

for at least 2 days (32.0%). In most situations (59.2%) the healthcare provider was not informed about the decision to use *M. oleifera* for medicinal benefits. Amongst those that informed their healthcare provider that they were using *M. oleifera*, the healthcare provider had accepted their decision. Up to 60.7% of respondents get information and recommendation to use the plant by a family member.

Effects of *M. oleifera* on the health of the community

Variable		Health Outcome		Frequency	Percent (%)
		Improved	Unknown		
Consume Moringa plant	Yes	419	0	419	99.3
	Never	0	3	3	0.7
Total		419	3	422	100

Table 4: *Consumption of Moringa oleifera plant by health outcome.*

Correlations			
		Consumption of Moringa plant	Health Outcome
Consumption of *M. oleifera* plant	Pearson Correlation	1	1.000**
	Sig. (2-tailed)		.000
	N	422	422
Health Outcome	Pearson Correlation	1.000**	1
	Sig. (2-tailed)	.000	
	N	422	422
**. Correlation is significant at the 0.01 level (2-tailed).			

Table 5: *Correlations between consumption of Moringa oleifera plant and health outcome.*

Trust in the effectiveness of *M. oleifera*	Frequency	Percent (%)
Yes	420	99.5
No	2	0.5
Total	422	100.0

Table 6: *Percentage distribution of trust that Moringa oleifera is effective in healing.*

Table 4 below shows that amongst the individuals that consume *M. oleifera* (99.3% of the respondents), all (100%) have reported

Consumption of *M. oleifera* for Nutritional Benefits	Frequency	Percent (%)
Yes	417	98.8
Never	5	1.2
Total	422	100.0

Table 7: *Percentage distribution of consumption of Moringa oleifera for nutritional benefits.*

improvement in their health statuses. Consumption of *M. oleifera* plant has shown a linear correlation with the health outcome of the individuals using it as shown in table 5 below.

Table 6 above shows that 99.5% of respondents believe that *M. oleifera* is effective in healing.

Table 7 above also shows the distribution of the percentage of respondents that consume *M. oleifera* for nutritional benefits. It can be seen that 98.8% of the respondents use *Moringa oleifera* plant for nutritional benefits.

Discussion

A variety of herbs are ingested for their medicinal benefits in different regions of the world. Studies have shown that the use of some of these herbs is beneficial to the health of individuals and communities [15,29]. *Moringa oleifera* (Lam) has stood out amongst the medicinal plants that have been studied by scientists because of its benefits in the treatment of many types of diseases [3,18,23]. It is important to understand the patterns of use of *M. oleifera* as an herb in order to gain more benefits from its nutritional and medicinal contents.

In line with other such studies that reported the numerous medicinal uses of *Moringa* [3,18,23] this research has shed more light on the medicinal properties of *Moringa* plant. The study has established the fact that the most common medicinal benefit of *M. oleifera* in Zaria communities in Nigeria was improvement of the symptoms of hypertension. It has also showed that *M. oleifera* is used to treat cough, fever, diabetes mellitus, arthritis, abdominal problems as well as headache. However, other reasons why people use *M. oleifera* include health promotion, hunger and for nutritional benefits. The best outcome for using *M. oleifera* as a medicinal plant was achieved in the treatment of hypertension. Similar findings have been reported earlier [17,29] in Ugandan rural communities where *Moringa* was used for the treatment of twenty-four medical conditions such as diabetes mellitus, malaria/fever, hypertension and syphilis as well as skin disease. In the South Asia, *M. oleifera* has also been used for the treatment of infections, inflammation, cardiovascular disease, abnormalities of the gastrointestinal system, anaemia and liver and kidney diseases [21,28,29].

Phytochemicals responsible for the effect of *Moringa* on hypertension include nitrile, mustard oil glycosides and thiocarbamate glycosides [9,29]. Earlier studies are therefore in support of the results from this research study as regards the best outcome seen in the use of *Moringa* plant to treat hypertension as well as its other medicinal benefits. Scientific studies on the healing effects of *Moringa* carried out in Nigeria and in other parts of the world have provided the basis for these findings [3,13,29].

It is noteworthy that within the study area all the individuals that consume *Moringa* plant experience improved health outcome. This may be the reason why most inhabitants of the community have a strong belief that *Moringa* plant is effective in healing and vice versa. However, empirical evidence from previous studies have confirmed the presence of pharmacological activities in extracts from the leaves of *M. oleifera* and its ability to reverse organic drug-induced injuries of the liver and kidneys [3,24,30]. The health improvement from consumption of *Moringa* plant may not be unrelated to its use as a food and its high nutritional value. It thus serves as a source of nutrients such as proteins, lipids, carbohydrates and vitamins which raise the nutritional status of the people in the community and lead to improved health status.

Conclusions and Recommendations

Finally, the study has confirmed that *Moringa oleifera* is being used for a variety of medicinal benefits and have positive influence on the health outcomes of the poor communities in Zaria, Nigeria. Our recommendation is that the public and private sector should collaborate to scale up the production of *Moringa oleifera* in the communities of Zaria, Nigeria in order to increase the value of the health of the populations.

Authors' Contributions

MIA conceived the study; UA designed the study protocol; UA carried out the Field work; MIA and UA carried out the analysis and interpretation of these data. MIA drafted the manuscript; UA critically revised the manuscript for intellectual content. The authors read and approved the final manuscript. The authors are guarantor of the paper.

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Conflicts of Interest

None declared.

Ethical Approval

Bibliography

1. Al-Numair KS., *et al*. "Ameliorative effect of kaempferol, a flavonoid, on oxidative stress in streptozotocin-induced diabetic rats". *Redox Report* 20.5 (2014): 198-209.
2. Ayinde BA., *et al*. "Isolation and characterization of two phenolic compounds from the stem bark of Musanga cecropioides R. Brown (Moraceae)". *Acta Phenolic Pharmacology* 64 (2007): 183-185.
3. Brilhante., *et al*. "Research advances on the multiple uses of *Moringa oleifera*: a sustainable alternative for socially neglected populations". *Asian Pacific Journal of Tropical Medicine* 10.7 (2017): 621-630.
4. Bowling A. "Research Methods in Health: Investigating Health and Health Services". 2nd edition. Open University Press. Philadelphia, USA (2002).
5. Caulier G., *et al*. "Review of saponin diversity in sea cucumbers belonging to the family Holothuriidae". *Beche-de-mer Information Bulletin* 31.1 (2011): 48-54.
6. Cheenpracha S., *et al*. "Potential anti-inflammatory phenolic glycosides from the medicinal plant *Moringa oleifera* fruits". *Bioorganic and Medicinal Chemistry* 18.17 (2010): 6598-6602.
7. Cordell GA. "Introduction to Alkaloids: pharmacology and biology". In: Alkaloids Chemical and Biological Perspectives. Volume 3. Wiley, New York (1983): 1-274.
8. Devbhuti D., *et al*. "Phytochemical and acute toxicity study on Tinospora tomentosa Miers". *Acta Phytochemical Pharmarcology* 66 (2009): 89-92.

9. Faizi S., *et al*. "Fully acetylated carbamate and hypotensive thiocarbamate glycosides from *Moringa oleifera*". *Phytochemistry* 38 (1995): 957-953.

10. Iqbal S and Bhanger MI. "Effect of Season and Production Location on antioxidant activity of *Moringa oleifera* leaves grown in Pakistan". *Journal of Food Composition and Analysis* 19 (2006): 544-551.

11. Easterby-Smith M., *et al*. "Management research". 4th edition. London: SAGE Publications (2012).

12. Faizi S., *et al*. "Isolation and structure elucidation of new nitrile and mustard oil glycosides from *Moringa oleifera* and their effect on blood pressure". *Journal of Natural Products* 57 (1994): 1256-1261.

13. Farooq F., *et al*. "Medicinal properties of *Moringa oleifera*: An overview of promising healer". *Journal of Medicinal Plants Research* 6.27 (2012): 4368-4374.

14. Guevara AP., *et al*. "An antitumor promoter from *Moringa oleifera* Lam". *Mutation Research Toxicol Environ Mutagen* 440.2 (1999): 181-188.

15. Idohou-Dossou N., *et al*. "Impact of daily consumption of Moringa (*Moringa oleifera*) dry leaf powder on iron status of senegalese lactating women". *AJFAND* 11.4 (2011): 4985-4999.

16. Idris SB and Adamu UR. "Phytochemicals and uses of *Moringa oleifera* leaves in humans and animals in Sokoto". *Journal of Animal Science and Veterinary Medicine* 3.1 (2018): 30-34.

17. Kasolo JN., *et al*. "Phytochemicals and uses of *Moringa oleifera* leaves in Ugandan Rural Communities". *Journal of Medical Plants Research* 4.9 (2010): 753-757.

18. Kilany OE., *et al*. "Anti-obesity potential of *Moringa oleifera* seed extract and lycopene on high fat diet induced obesity in male Sprauge Dawely rats". *Saudi Journal of Biological Sciences* (2020): 1-14.

19. Kumari DJ. "Hypoglycaemic effect of *Moringa oleifera* and Azadirachta indica in type 2 diabetes mellitus". *Bioscan* 5.20 (2010): 211-214.

20. Luo C., *et al*. "Kaempferol alleviates insulin resistance via hepatic IKK/NF-κB signal in type 2 diabetic rats". *International Immunopharmacology* 28 (2015): 744-750.

21. Morimitsu Y., *et al*. "Antiplatelet and anticancer isothiocyanates in Japanese horseradish, wasabi". *Bio Factors* 13 (2000): 271-276.

22. Moyo, B., *et al*. "Nutritional characterization of Moringa (*Moringa oleifera* Lam.) leaves". *African Journal of Biotechnology* 10.60 (2011): 12925-12933.

23. Mughal MH., *et al*. "Improvement of drumstick (Moringa pterygosperma Gaertn.) – a unique source of food and medicine through tissue culture". *Hamdard Medicine* 42 (1999): 37-42.

24. Nafiua AO., *et al*. "Effect of fatty acids from ethanol extract of *Moringa oleifera* seeds on kidney function impairment and oxidative stress induced by gentamicin in rats". *Biomedicine and Pharmacotherapy* 117 (2019): 3-10.

25. Nikkon F., *et al*. "*In vitro* antimicrobial activity of the compound isolated from chloroform extract of *Moringa oleifera* Lam". *Pakistan Journal of Biological Sciences* 6.22 (2003): 1888-1890.

26. Ouédraogo M., *et al*. "Protective effect of *Moringa oleifera* leaves against gentamicin-induced nephrotoxicity in rabbits". *Experimental and Toxicologic Pathology* 65.3 (2013): 335-339.

27. Ruckmani K., *et al*. "Effect of *Moringa oleifera* Lam on paracetamol-induced hepatotoxicity". *Indian Journal of Pharmaceutical Sciences* 60.1 (1998): 33-35.

28. Siddhuraju P and Becker K. "Antioxidant properties of various solvent extracts of total phenolic constituents from three different agroclimatic origins of drumstick tree (*Moringa oleifera* Lam.)". *Journal of Agricultural and Food Chemistry* 15 (2003): 2144-2155.

29. Stevens GC., *et al*. "Ethno-medicinal and culinary uses of *Moringa oleifera* Lam. in Nigeria". *Journal of Medicinal Plants Research* 7.13 (2013): 799-804.

30. Toppo R., *et al*. "Hepatoprotective activity of *Moringa oleifera* against cadmium toxicity in rats". *Veterinary World* 8.4 (2015): 537-540.

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