COMMUNITY PERCEPTION AND UTILIZATION OF *MORINGA OLEIFERA* IN OHAUKWU LOCAL GOVERNMENT AREA, EBONYI STATE, SOUTHEASTERN NIGERIA

ONYIDO, Angus Ejidikeme, ELOSIUBA, Nwanneka Victoria, ANYIKWA, Nkiruka Oluebube, CHIKWENDU, Joy Ifeyinwa, IKEH, Roseline Ekene, UMEANAETO, Pauline Ukamaka and IMAKWU, Cyril Ali

Department of Parasitology and Entomology, Faculty of Biosciences, Nnamdi Azikiwe University, Awka, Anambra State, Nigeria.

Corresponding Author: Elosiuba, N. V. Department of Parasitology and Entomology, Faculty of Biosciences, Nnamdi Azikiwe University, Awka, Anambra State, Nigeria. **Email:** vn.elosiuba@unizik.edu.ng **Phone:** +234 8060376671

Received *February 28, 2022;* ***Revised*** *April 10, 2022;* ***Accepted*** *April 13, 2022*

ABSTRACT

Moringa oleifera is one of nature's amazing plants that is nutritionally and medicinally beneficial to man. This study was aimed at determining the people's knowledge, utilization and distribution of Moringa in Ohaukwu Local Government Area of Ebonyi State. Three towns were selected from the LGA, 450 respondents participated in the study. House visits were used to reach the people. Interviewer administered and structured questionnaires were used to gather information from the participants. Distribution of M. oleifera plants was estimated by counting the plant stands in the compounds visited. Utilization of M. oleifera was subdivided into nutrition, agriculture, medicine and cultural uses. The knowledge of M. oleifera by the people varied among the sexes. More females 108(65.06 %) than the males 58(34.94 %) had knowledge of M. oleifera plant. Knowledge of the plant decreased with increased educational status. It varied with different occupational groups being highest among farmers and least among the drivers. M. oleifera were found growing luxuriantly in the three clans but sparsely distributed due to felled Moringa trees. The plant population ranged from 7 to 11 stands in the study communities. Uses of M. oleifera include: human nutrition, animal shed, fodder and in treating various ailments. Ailments commonly treated with M. oleifera include; toothache, constipation, catarrh, sore throat, helminthiasis and rheumatism. Following the dearth in knowledge of the plant among youths and its sparse distribution, there is need for planting of M. oleifera in the community for better knowledge and utilization by the people.

Keyword: *Moringa oleifera*, Drumstick tree, Knowledge, Community perception, Utilization

INTRODUCTION

Moringa oleifera Lam. (Brassicales, Moringaceae) is a fast growing deciduous shrub that grows up to 12 m tall and 30 cm in diameter with an umbrella-shaped open crown (Ramachandran *et al.,* 1980). It is known as Drumstick tree, Horseradish tree or Ben oil tree in English. It is a small to medium-sized, evergreen or deciduous tree native to northern India, Pakistan and Nepal (Palada and Chang, 2003). It is a soft wood tree with a timber of low quality. *M. oleifera* is a plant which can be found in a variety of climates and substandard soils. It is one of the world's most useful trees as almost every part of the tree can be used for food, medicine or other beneficial products (Dhakar *et al*., 2011). All parts of the *Moringa*

tree are edible but the roots which are used as condiment in the same way as horseradish contain the alkaloid spirochin, a potentially fatal nerve paralyzing agent (Makkar and Becker, 1997). The seed powder serves as natural coagulant which can clarify very turbid water removing up to 99 % of the bacteria in the process (Valverde *et al*., 2018). Medicinally, *Moringa* preparations have been cited in scientific literature as having efficacy on specific pathogenic parasites like helminths including *Dracunculus, Schistosoma* and *Trypanosoma* (Fahey, 2005; Fatima *et al*., 2014; Tayo *et al*., 2014; Carbado and Portugaliza, 2017). *M. oleifera* has also been described to be effective in the treatment of some bacterial infections, as well as being a potent therapy for arthritis. It has also been used in the treatment of diabetes (Gopalakrishnan *et al*., 2016). According to Okonkwo *et al.* (2014) *M. oleifera* seed oil can be used for larval control of mosquitoes (*Aedes aegypti*). It has been reported that juice extracted from the leaves of *M. oleifera* has strong antibacterial and antimalarial properties (Gbeassor *et al,*, 1990). *M. oleifera* also have considerable efficacy in water purification by flocculation (Ravikumar and Udayakumar, 2020), sedimentation, antibiosis and even reduction of schistosome cercariae titer (Gassenschmidt *et al.,* 1995; Yongabi, 2004). The activity of *M. oleifera* can help reduce rates of diseases like trachoma, schistosomiasis, ancylostomiasis (hook worm), diarrhoea, ascariasis, trichuriasis and encephalities especially in children who bear the greatest health burden associated with unsafe water supplies (Sridhar and Oloruntoha, 2008).

In view of the immense benefits of *M. oleifera* this study was designed to assess the knowledge, utilization and distribution of *Moringa* plant among the inhabitants of some communities in Ohaukwu LGA of Ebonyi State and also, to specifically determine the general, medicinal and cultural uses of *M. oleifera* in these communities.

MATERIALS AND METHODS

Study Area: The study was carried out in Ohaukwu Local Government Area (LGA) of Ebonyi State, South Eastern Nigeria. Ohaukwu LGA is located in the Northern part of Ebonyi State. It occupies an area of 517 kilometres and lies between latitudes $8^0 1^I 0^{II}$ East and longitudes $6^0 30^I 0^{II}$ North (Maplandia, 2022). It has a population of about 258,700 inhabitants according to the 2016 National Population Commission Projection figures.The LGA is bounded to the east by Ishielu LGA, to the north by Benue State, to the west by Ebonyi LGA. It has its headquarters at Ezzangbo. The climate is typically tropical with characteristic rain forest vegetation. It has an annual rainfall range of between 1500 and 2000 mm and average daily temperature of 26 ± 4^0C. There are two distinct seasons, the wet and the dry seasons, the wet season covers the period between March to November, while the dry season is from December to February (Weather Spark, 2022). The inhabitants are mainly farmers and petty traders. The enterprise that has gained prominence among the people is garri processing. This business has made the Local Government popular throughout Nigeria.

Study Design: A cross-sectional survey was used to collect information from all the segments of the chosen autonomous communities.

Sample Size: Participants were selected from 3 different autonomous communities namely Ngbo, Ezzangbo and Effium. A total of 450 participants comprised of 206(45.78 %) males and 244(54.22 %) females within the age range of 11 – 90 years were selected for the study. Individual participants were selected by convenience or non-probability methods hence only available people in a homestead were interviewed.

Ethical Consideration: Ethical approval for conducting the study was sought from the authorities of Ohaukwu Local Government Area. In each of the subsequent autonomous communities where the study was carried out, approval was sought from their respective traditional rulers.

Method of Data Collection: House visits were used to reach the individual homesteads. In each homestead 1 to 3 people of different age groups were interviewed and none of them was aware of the responses from the others. Interviewer-administered closed ended structured questionnaire was used to obtain information from the study participants with the help of an interpreter. Questionnaire was face validated, pretested and tested for reliability before administration (Roopa and Rani, 2012). The data sought by the questionnaires included the age, sex, occupation, educational status and the knowledge, distribution and utilization of *M. oleifera* in the different communities.

Data Analysis: Data obtained was analysed using Chi-Square cross tabulation and percentages. Statistical significance was set at 95 % confidence level.

RESULTS

Demographic Data of Participants: Four hundred and fifty participants were involved in the study. Female participants were 244(54.22 %), while male participants were 206(45.78 %) (Table1). More males 76(50.67 %) than females 74(49.33 %) were from Ngbo community, while more females than males were from both Ezzangbo (females 60.00 % and males 40.00 %) and Effium (females 53.33 % and males 46.67 %) communities. Their age group varied from 11 to 90 years. At Ngbo community, the age group 41 – 50 had the highest participants 30(20.00 %), whereas at Ezzangbo and Effium communities the highest participation was among the age group 31 – 40 years; 32(21.33 % and 36(24.00 %) respectively (Table 2). By education, the highest number of participants had secondary education in Ngbo and Ezzangbo communities [77(51.33 %) and 46(30.67 %)], while the highest number of participants from Effium community had primary education 41(27.33 %) (Table 3). In Ngbo Community, the highest number of participants 28(18.67 %) were labourers and the least 2(1.33 %) were herbalists. In Ezzangbo Community, an equal number of farmers and labourers, 35(23.33 %) each, had the highest number of participants while tailors, herbalists and pensioners had the least participants, 1(0.67 %) each. In Effium Community, farmers and traders were the highest with an equal number of participants, 32(21.33 %) each, while pastors, mechanics and herbalists had the least number of participants, 1(0.67 %) each (Table 4).

Distribution of *M. oleifera* in the Area: The distribution of *M. oleifera* in the three communities of Ohaukwu LGA is shown in Table 5. In Ngbo Community, 11 compounds had *M. Oleifera trees,* 4(36.36 %) *Moringa* trees were planted by the participants while 7 (63.64 %) were planted by older members of their families. In Ezzangbo Community, 7 compounds had *M. oleifera* trees, 4(57.14 %) *M. Oleifera* trees were planted by the participants, while 3(42.86 %) was planted by older members of their families. In Effium Community, 9 compounds had *M. oleifera* trees planted in them, 2(22.22 %) *Moringa* trees were planted by the participants while 7(77.78 %) were planted by older members of their families.

Utilization of *M. oleifera* in the Area: The utilization of *M. oleifera* in the three communities of Ohaukwu LGA was grouped into four categories namely human nutrition, agriculture, medicine and cultural uses (Table 6). Out of the 450 participants studied, 45(27.11 %) utilize *Moringa* nutritionally.

Agriculturally, 94 (56.63 %) participants use *Moringa* for various types of agricultural purposes. Also 26(15.66 %) participants utilize *Moringa* plant medically. Only 1(0.60 %) of the participants who claimed that *Moringa* plays a role in their traditional masquerade festival rite of passage, but could not explain. The difference in uses of *M. oleifera* in the three clans were statistically significant ($p<0.05$).

DISCUSSION

More females (54.22 %) than males (45.78 %) participated in this study. Most of the men were civil servants, farmers, traders or labourers who could not afford to wait for the health workers without any scheduled time for coming.

Table 1: Number of participants in a study on the perception and utilization of *Moringa oleifera* in Ohaukwu Local Government Area, Ebonyi State, Nigeria

Community	Number of participants	% of participants	Number of males	% of males	Number of females	% of females
Ngbo	150	33.33	76	50.67	74	49.33
Ezzangbo	150	33.33	60	40.00	90	60.00
Effium	150	33.33	70	46.87	80	53.33
Total	450	100	206	45.78	244	54.22

Table 2: Age group of the study participants in a study on the perception and utilization of *Moringa oleifera* in Ohaukwu Local Government Area, Ebonyi State, Nigeria

Community	Age group	Number of Participants	% of participants	Number of males	% of males	Number of females	% of females
Ngbo	11 – 20	18	12.00	7	38.89	11	61.11
	21 – 30	27	18.00	12	44.44	15	55.56
	31 – 40	19	12.67	11	57.89	8	42.11
	41 – 50	30	20.00	17	56.67	13	43.33
	51 – 60	21	14.00	19	42.86	12	57.14
	61 – 70	20	13.33	12	60.00	8	40.00
	71 – 80	14	9.33	8	57.14	6	42.86
	81 – 90	1	0.67	0	0.00	1	100
Sub total		150	100	76	50.67	74	49.33
Ezzangbo	11 – 20	9	6.00	5	55.56	4	44.44
	21 – 30	32	21.33	12	37.50	20	62.50
	31 – 40	32	21.33	13	40.63	19	59.38
	41 – 50	28	18.67	12	42.86	16	57.14
	51 – 60	28	18.67	12	42.86	16	57.14
	61 – 70	20	13.33	5	25.00	15	75.00
	71 – 80	1	0.67	1	100.00	0	0.00
	81 – 90	0	0.00	0	0.00	0	0.00
Sub Total		150	100	60	40	90	60
Effium	11 – 20	19	12.67	9	47.37	10	52.63
	21 – 30	29	19.33	15	51.72	14	48.28
	31 – 40	36	24.00	14	38.89	22	51.11
	41 – 50	26	17.33	12	46.15	14	53.85
	51 – 60	25	16.67	13	52.00	12	48.00
	61 – 70	15	10.00	7	46.67	8	53.33
	71 – 80	0	0.00	0	0.00	0	0.00
	81 – 90	0	0.00	0	0.00	0	0.00
Sub total		150	100	70	46.67	80	53.33
Grand total		450		206	45.78	244	54.22

Table 3: Educational status of the study participants in a study on the perception and utilization of *Moringa oleifera* in Ohaukwu Local Government Area, Ebonyi State, Nigeria

Community	Educational status	Number of Participants	% of participants	Number of males	% of males	Number of female	% of female
Ngbo	Non-formal	55	36.67	25	45.45	30	54.55
	Primary	3	2.00	2	66.67	1	33.33
	Secondary	77	51.33	42	54.55	35	45.45
	Tertiary	15	10.00	7	46.67	8	53.33
Sub total		150	100	76	50.67	74	49.33
Ezzangbo	Non-formal	41	27.33	12	29.27	29	70.73
	Primary	43	28.67	14	32.56	29	67.44
	Secondary	46	30.67	22	47.83	24	52.17
	Tertiary	20	13.33	12	60.00	8	40.00
Sub total		150	100	60	40.00	90	60.00
Effium	Non-formal	40	26.67	18	45.00	22	55.00
	Primary	41	27.33	17	41.46	24	58.54
	Secondary	39	26.00	19	48.72	20	51.28
	Tertiary	30	20.00	16	53.33	14	46.67
Sub total		150	100	70	46.67	80	53.33

Grand Total	450	100	206	45.78	244	54.22

Table 4: Occupations of the participants in a study on the perception and utilization of *Moringa oleifera* in Ohakwu Local Government Area, Ebonyi State, Nigeria

Occupation of Participants	Ngbo		Ezzangbo		Effium	
	Number of Participants	% of participants	Number of Participants	% of participants	Number of Participants	% of participants
Students	21	14.00	16	10.67	25	16.67
Pastors	3	2.00	0	0.00	1	0.67
Civil servants	21	14.00	14	9.33	11	7.33
Traders	22	14.67	27	18.00	32	21.33
Mechanics	3	2.00	2	1.33	1	0.70
Teachers	11	7.33	11	7.33	17	11.30
Farmers	23	15.33	35	23.33	32	21.30
Pensioners	12	8.00	1	0.67	0	0.00
Labourers	28	18.67	35	23.33	0	0.00
Herbalists	2	1.33	1	0.67	1	0.67
Drivers	4	2.67	7	4.67	0	0.00
Tailors	0	0.00	1	0.67	4	2.67
Total	150	100 %	150	100 %	150	100 %

Table 5: Distribution of *M. oleifera* in a study on the perception and utilization of *Moringa oleifera* in Ohaukwu Local Government Area, Ebonyi State, Nigeria

Community	Questions fielded	Number of yes responses	% of yes responses	Number of males	% of males	Number of Females	% of females
Ngbo	Number of *M. oleifera* found in compounds.	11	100.00	6	54.55	5	45.45
	Was it planted by you?	4	36.36	1	25.00	3	75.00
	Was it planted by older members of your family	7	63.64	3	42.86	4	57.14
Ezzangbo	Number of *M. oleifera* found in compounds.	7	100.00	4	57.14	3	42.86
	Was it planted by you?	4	57.14	3	75.00	1	25.00
	Was it planted by older members of your family?	3	42.86	3	100.00	0	0.00
Effium	Number of *M. oleifera* found in compounds.	9	100.00	3	33.33	6	66.67
	Was it planted by you?	2	22.22	0	0	2	100.00
	Was it planted by older members of your family?	**7**	**77.78**	**5**	**71.43**	**2**	28.57

Table 6: Uses of *Moringa* plant in a study on the perception and utilization of Moringa oleifera in Ohaukwu Local Government Area, Ebonyi State, Nigeria

Uses	Number of Participants	% of Participants	Number of males	% of males	Number of Females	% of females
Human nutrition	45	27.11	15	33.33	30	66.67
Agriculture	94	56.63	32	34.04	62	65.96
Medicine	26	15.66	10	38.46	16	61.54
Cultural	1	0.60	1	100.00	0	0.00
Total	166	100	58	34.94	108	65.06

Hence men could regard the exercise as time wasting despite being informed properly. Females were usually more available at home than their male counterparts who move out early to their farms and other pursuits for feeding the family. However, it has been reported that females pay more attention to their heath than males (WHO, 2011). The age interval of 31 – 40 years recorded the highest number of participants suggesting that a good number of the study participants were young adults, especially women of reproductive age who were either pregnant or nursing mothers, tending their children and preparing meals for their husbands who have gone to work. Educational status of the participants showed that the highest percentage of participants had only secondary education (36.00 %), with the least having tertiary education (14.44 %). This may be as a result of poverty, ignorance or pure lack of interest or exposure (Eneh, 2011).

Moringa plant was scarce in Ohaukwu LGA. It was observed that a lot of homes visited did not have the plant. The younger population had little knowledge of *Moringa* and its benefits. Most of the older populations who knew *Moringa* plant seem not to have interest in the propagation of this plant because most of the existing *Moringa* plants were not planted by the current occupants of most compounds visited. This was in line with previous report by Odeyinka *et al.* (2007). As a result of the dearth of knowledge of *Moringa* plant in this community, utilization of the plant was generally low, only one third of the participants made use of the plant in one way or the other. Four categories of uses were identified namely human nutrition, agriculture, medicine and cultural uses. Among the participants, fewer males than females utilized *M. oleifera* in one form or the other. There was significant difference in the utilization of the plant among the sexes.

The study participants in Ohaukwu community made use of *Moringa* plant for human nutrition in the form of their leaves, seeds, pod and flowers. In the nutritional uses, the leaves of *Moringa* appear to be the most popular part of the tree that is consumed among the participants. Even though *Moringa* leaves are not the vegetable of choice in this LGA, a few of the study participants who are aware of its benefits have made it an accepted vegetable into their diets. In a few homes, because of their knowledge of the leaves nutritional values, it is gradually taking the place of the popular fluted pumpkin leaves (ugu), as a more healthy vegetable to consume. This finding was in agreement with previous reports on *M. oleifera* (Gupta *et al*., 2018; Xiao *et al*., 2020) whose work enumerated lots of nutrients found in processed products of *M. oleifera*.

Agriculturally the *Moringa* tree is used for animal shade especially those who have the tree in their compound, a few use the tree for manure preparation but most importantly, the leaves are given to their female sheep and goats with new kids for increased milk production. This observation was in line with those of Ozumba (2008). They were not used for yam staking or for boundary marking.

Among the medicinal uses of the plant, the leaves were mostly used by the people for the treatment of constipation, catarrh, sore throat (a drink made from boiled leaves and mixed with honey), sores and wound (a paste of the leaves) and malnutrition. A small percentage of the study population used the stem in treatment of worm infestation. This agrees with the work of Fuglie (1999) which reports the use of *Moringa* for the treatment of helminth infestation. Fuglie (1999) observed that children fed with *Moringa* leaf power had increased weight and improved overall health, while pregnant women placed on *Moringa* leaf power recovered form anaemia, had babies with higher birth weight and breast feeding women increased their production of milk.

In the aspect of cultural beliefs, only one participant claimed that *Moringa* plant plays a role in their traditional masquerade festival rite of passage, but could not give details of how.

Conclusion: *M. oleifera* still remains unpopular in Ohaukwu LGA of Ebonyi State, Nigeria, despite its acclaimed economic values and importance. Majority of the study participants

claimed not to be aware of the plant but a lot of them showed their willingness to cultivate *Moringa* if introduced to them. There is therefore, the need to popularize *M. oleifera* plant among Ebonyi inhabitants especially those living in Ohaukwu LGA of the state. This will help increase the knowledge and utilization of *Moringa* as a beneficial plant. The inhabitants of Ohaukwu LGA need an in-depth understanding of the medicinal uses of this wonderful gift of nature in other to better manage and utilize it and also to incorporate its benefits to their daily living. This will also help reduce the rate of tree abuse especially in places where the tree was found chopped down.

ACKNOWLEDGEMENTS

The authors acknowledge the authorities in Ohaukwu LGA headquarters and the traditional rulers of the different autonomous communities visited for their assistance and cooperation throughout the study period.

REFERENCES

CARBADO Jr, D. E. and PORTUGALIZA, H. P. (2017). Antihelminthic activity of *Moringa oleifera* seed aqueous and ethanolic extracts against *Haemonchus contortus* eggs and third stage larvae. *International Journal of Veterinary Sciences and Medicine*, 5(1): 30 – 34.

DHAKAR, R. C., MAURYA, S. D., POONIYA, B. K., BAIRWA, N. and GUPTA, M. S. (2011). Moringa: the herbal gold to combat malnutrition. *Chronicles of Young Scientists,* 2(3): 119 – 125.

ENEH, O. C. (2011). Nigeria's vision 20:20:20 – issues, challenges and implication for development management. *Asian Journal of Rural Development,* 1(1): 21 – 40.

FAHEY, J. W. (2005). *Moringa oleifera*: a review of the medical evidence for its nutritional, therapeutic, and prophylactic properties. Part 1. *Trees for Life Journal*, 1(5): 1 – 15.

FATIMA, T., SAJID, M. S., JAWAD-UL-HASSAN, M., SIDDIQUE, R. M. and IQBAL, Z. (2014). Phytomedicinal value of *Moringa oleifera* with special reference to antiparasitics. *Pakistan Journal of Agricultural Sciences*, 51(1): 251 – 262.

FUGLIE, L. J. (1999). *The Miracle Tree: Moringa oleifera Natural Nutrition for the Tropics.* Training Manual, Church World Service, Dakar, Senegal.

GASSENSCHMIDT, U., JANY, K. D., BERNHARD, T. and NIEBERGALL, H. (1995). Isolation and characterization of a flocculating protein from *Moringa oleifera* Lam. *Biochimica et Biophysica Acta (BBA)-General Subjects*, 1243(3): 477 – 481.

GBEASSOR, M., KEDJAGNI, A. Y., KOUMAGLO, K., DE SOUZA, C., AGBO, K., AKLIKOKOU, K. and AMEGBO, K. A. (1990). In vitro antimalarial activity of six medicinal plants. *Phytotherapy Research*, 4(3): 115 – 117.

GOPALAKRISHNAN, L., DORIYA, K. and KUMAR, D. S. (2016). *Moringa oleifera*: a review on nutritive importance and its medicinal application. *Food Science and Human Wellness*, 5(2): 49 – 56.

GUPTA, S., JAIN, R., KACHHWAHA, S. and KOTHARI, S. L. (2018). Nutritional and medicinal applications of *Moringa oleifera* Lam. – Review of current status and future possibilities. *Journal of Herbal Medicine*, 11: 1 – 11.

MAPLANDIA (2022). *Nigeria Google Satellite Map*. Maplandia.com. http://www.maplandia.com/Nigeria/ Accessed January 11, 2022.

MAKKAR, H. P. S. and BECKER, K. (1997). Nutrients and antiquality factors in different morphological parts of the *Moringa oleifera* tree. *Journal of Agricultural Science*, 128(3): 311 – 322.

ODEYINKA, S. M., TORIMIRO, D. O., OYEDELE, J. O. and ASAOLU, V. O. (2007). Farmers awareness and knowledge of *Moringa oleifera* in Southwestern Nigeria: a perceptional analysis. *Asian Journal of Plant Sciences*, 6(2): 320 – 325.

OKONKWO, N. J., NWANKWO, E. N., IBEABUCHI, U., OKAFOR, E. G., UKONZE, B. C., OGBONNA, C. U., EGBUCHE, C. M., CHIKEZIE, F. M. and OBIECHINA, I. O. (2014). Evaluation of *Moringa oleifera* (Lam) (Moringaceae) seed oil for larval

control of *Aedes aegypti* L. (Diptera: Culicidae). *The International Journal of Science and Technoledge*, 2(12): 75 – 81.

OZUMBA, N. A. (2008). *Moringa oleifera: A Review of its Medicinal and Other Uses*. Institute for Development Studies, University of Nigeria, Enugu Campus, Enugu, Nigeria.

PALADA, M. C. and CHANG, L. C. (2003). Suggested cultivation practices for *Moringa*. *AVRDC Publication,* 03-545. https://himalayanblossoms.com/PDF%20Files/Sijan/Suggested % 20Cultural %20Practices.pdf

RAMACHANDRAN, C. O., PETER, K. V. and GOPALAKRISHNAN, P. K. (1980). Drumstick (*Moringa oleifera*): a multipurpose Indian vegetable. *Economic Botany,* 34(3): 276 – 283.

RAVIKUMAR, K. and UDAYAKUMAR, J. (2020). *Moringa oleifera* seed composite a novel material for hazardous heavy metals (Cd, Cr and Pb) removal from aqueous systems. *Journal of Materials and Environmental Sciences,* 11(1): 123 – 138.

ROOPA, S. and RANI, M. S. (2012). Questionnaire designing for a survey. *Journal of Indian Orthodontic Society*, 46(4 Suppl. 1): 273 – 277.

SRIDHAR, M. K. C. and OLORUNTOBA, E. O. (2008). Water, development, health and the nigerian millennium development goals. Chapter 5, Pages 83 – 112. *In:* AGBOLA, T., OLATUBARA, C. P., WAHAB, B., SANNI, L. and IPINGBEMI, O. (Eds.). *Enviromental Planning and Health in Nigeria: Essays in Honor of Professor Timothy Olayiwola Egunjobi.* Development of Urban and Regional Planning, University of Ibadan, Ibadan.

TAYO, G. M., PONÉ, J. W., KOMTANGI, M. C., YONDO, J., NGANGOUT, A. M. and MBIDA, M. (2014). Anthelminthic activity of *Moringa oleifera* leaf extracts evaluated in vitro on four developmental stages of *Haemonchus contortus* from goats. *American Journal of Plant Sciences*, 2014: 46194. http://dx.doi.org/10.4236/ajps.2014.511185

VALVERDE, K. C., COLDEBELLA, P.F., SILVA, M. F., NISHI, L., BONNGIOVANI, M. C. and BERGAMASCO, R. (2018). *Moringa oleifera* Lam. and its potential association with aluminium sulphate in the process of coagulation/ flocculation and surface water. *International Journal of Chemical Engineering,* 2018: 4342938. https://doi.org/10.1155/2018/4342938

WEATHER SPARK (2022). *Climate and Average Weather Year Round in Abakaliki Nigeria*. Weatherspark.com. https://weatherspark.com/y/58525/Average-Weather-in-Abakaliki-Nigeria-Year-Round Accessed January 11, 2022.

WHO (2011). *Cause of Death 2008: Data Sources and Methods*. Department of Health Statistics and Informatics, World Health Organization, Geneva, Switzerland. http://www.who.int/healthinfo/global_burden_dis

XIAO, X., WANG, J., MENG, C., LIANG, W., WANG, T., ZHOU, B., WANG, Y., LUO, X., GAO, L. and ZHANG, L. (2020). *Moringa oleifera* Lam and its therapeutic effects in immune disorders. *Frontiers in Pharmacology*, 11: 566783. https://doi.org/10.3389/fphar.2020.566783

YONGABI, K. A. (2004). Studies on the potential use of medicinal plants and macrofungi (lower plants) in water and waste water purification. Pages 1 – 14. *In: Proceedings of an E-seminar Organized by the International Organization for Biotechnology and Bioengineering (IOBB),* Stockholm, Sweden.