
DIETARY INTAKE, ANTHROPOMETRY AND BLOOD GLUCOSE OF MORINGA USERS AND NON USERS WHO LIVES WITH DIABETES

¹ADEOSUN, F.F., ²OGBEBA, J., ³SAMUEL E. AND ¹ABDULLAHI, Y.J.

¹Department of Nutrition and Dietetics, Federal Polytechnic Bauchi, Bauchi state, Nigeria. ²Department of Science Laboratory Technology, Federal Polytechnic Bauchi. ³Department of Food Science and Technology, Federal Polytechnic Bauchi.

Abstract

Studies have shown the antidiabetic effect in humans of Moringa oleifera among many other uses. This study is aimed at assessing moringa users and non- users who lives with diabetes and visited Specialist Hospital Jos, Plateau state. It was a cross sectional survey, where 200 questionnaires were administered to randomly selected respondents who visited the diabetes clinic of the facility. Data on socio-demography, food intake using 24 hours dietary recall, anthropometry using weight and height measurements and blood glucose using glucometers were obtained. Statistical package for social sciences (SPSS) version 20 was used to analyze data. The results shows that 52% of PLWD in this study consumed MO. Majority of MO users consume it weekly (48.1%); Moringa leaves (47.1%); check blood sugar after consumption (76.9%); were >46 years (36.5%), female (52.9%), secondary school leavers (32%), married (51%) and full time house wife (40%). Overweight (34.6%;35.4%) and obesity (42.3%;57.3%) are pronounced in both users and non-users of MO respectively among PLWD. The mean energy intake of both users (2550.21Kcal) and non users (1658.11Kcal) were below the RDA(2950Kcal) and the mean fiber intake of users(49.12g) was above RDA(38g) but non user (26.27g) was below the RDA. The fasting blood sugar of users of MO shows lesser hyperglycaemia (29.8%) than that of non-users (47.9%) in this study. In conclusion, MO users had better fibre intake, protein, anthropometry and less hyperglycaemia than non-users among PLWD.

Keywords: *Moringa Olifera*, diabetes, diet intake, anthropometry, blood glucose

Introduction

Diabetes mellitus is recognized as being a syndrome, a collection of disorders that have hyperglycemia and glucose intolerance as their hallmark, due either to insulin deficiency or to the impaired effectiveness of insulin's action, or to a combination of these [Fatoumata *et al.*, 2020]. *Moringa oleifera* (MO) is a plant that is used for several purposes among which are in human nutrition and medicinal herbs to manage diseases such as diabetes [Leone *et al.*, 2015; Popoola & Obembe, 2013]. This tree is important because its flowers, pods, and leaves have medicinal uses. It has been reported that the flower contains a stimulant and is used to treat inflammation; the spots and seeds have liver-protective and antihypertensive properties, while the leaves have been used to treat microbial infections and to control glucose levels. The leaves are eaten as vegetables or food ingredient because of the high content of vitamins, antioxidants and macronutrients to improve nutritional deficiencies [Barichella *et al.*, 2018; Ntila *et al.*, 2018]. *Moringa oleifera* is a rich source of phytochemicals and important nutrients that can have positive effects on health. It was found to contain various phytochemicals including uncommon sugar-modified glucosinolates. Administration of MO extract and leaf in non-diabetic subjects and diabetic animal models indicate decrease in blood sugar and improve glucose tolerance [Olayaki *et al.*, 2015; Gupta *et al.*, 2012]. The presence of fiber, flavonoids, phenolic acids among other substances in the leaves which produce amylase inhibition activity are attributed to anti-diabetic effect of MO [Tadera *et al.*, 2006]. This would reduce the movement of the starch intestinal digestion and of the glucose intestinal absorption, reducing the postprandial glycemic peak, and thus reducing, presumably, the risk of developing diabetes and improving the management of glycaemia in diabetic subjects. Therefore, this study aims to assess dietary intake, anthropometry, and blood glucose of *Moringa oleifera* (MO) users and non-users among persons living with diabetes (PLWD).

Materials and Methods

Description of study area

The study was carried out at specialist Hospital Jos, Plateau state. It provides specialized medical service, trains health professionals and serves as a research

institute. The diabetic patients have their clinics on Mondays, Wednesdays and Thursdays.

Study design

A health facility based cross-sectional study was used. This design was adopted because it gives an overview of what is obtainable with the variables of interest. This study provided information on dietary intake, anthropometry, and blood glucose of *Moringa Olifera* users and non-users among persons living with diabetes (PLWD) who visited Specialist Hospital Jos, Plateau state.

Study population

The study population comprised of people living with diabetes who used or did not use *Moringa Olifera*

Sample Size

The sample size =200

$$\text{Formula} = \frac{n Z^2 \times P (1-p)}{d^2}$$

Where

n= is the required sample size of 95% (standard value of 1.96)

P= In Nigeria, chronic diseases are projected to account for 13.7% of all deaths (WHO, 2015)

d= precision on margin error at 5% (standard value of 0.05)

$$\text{Sample size } n = \frac{Z^2 \times P (1-p)}{d^2} = \frac{1.962 \times 0.137(1-0.137)}{0.052} = \frac{3.8416 \times 0.118231}{0.0025}$$

$$n = \frac{0.4541962}{0.0025}$$

Attrition

$$\frac{181.67848 \times 10}{100}$$

$$=18.167848$$

$$181.67848+18.167848$$

$$=199.8$$

200

Sampling procedure

The study includes people living with diabetes in outpatient department and exclude hospitalized people living with diabetes. Simple random sampling was used to select the respondents

ETHICAL CONSIDERATION

The consent was obtained from the hospital management, before the questionnaire was administered to the respondents

DATA COLLECTION TOOLS

A structured questionnaire was used to collect data from the respondents; bathroom weighing scale was used to take the weight of the respondents also heightometer was used.

DATA COLLECTION

Data was collected through structured questionnaire administered by the researcher. The questionnaires comprise four sections:

1. The Socio Demographic data of the respondents
2. The glucose level of the respondents.
3. The dietary intake of the respondents using 24 hours dietary recall
4. The effect of Moringa consumption among the respondents.

DATA ANALYSIS

Data was coded and analyzed using Statistical package for social sciences (SPSS) version 20 to analyze the data. 24 hours dietary recall and correlation was done in order to predict the significant values with p value of 0.05.

Results and Discussion

Table 1a Demographic and Socio-economic Characteristics of study participants

Variables	Users	Non-Users	Total Percentage (%)	
	F (%)	F (%)	F	(%)
Age				
15-25	14 (13.5)	18 (19.0)	32	16.0
26-35	18 (17.3)	28 (29.0)	46	23.0
36-45	34 (32.7)	22 (23.0)	56	28.0
46 and above	38 (36.5)	28 (29.0)	66	33.0
Total	104 (100.0)	96 (100.0)	200	100.0
Sex				
Male	49 (47.1)	56 (58.3)	105	52.5
Female	55 (52.9)	40 (41.7)	95	47.5
Total	104 (100.0)	96 (100.0)	200	100.0
Education Level				
Primary	20 (19.0)	20 (20.8)	40	20.0
Secondary	33 (32.0)	23 (24.0)	56	28.0
Tertiary	21 (20.0)	33 (34.4)	54	27.0
None	30 (29.0)	20 (20.8)	50	25.0
Total	104 (100.0)	96 (100.0)	200	100.0
Marital Status				
Married	53 (51.0)	43 (44.8)	96	48.0
Single	33 (31.7)	48 (50.0)	81	40.5
Divorce	01 (01.0)	00 (00.0)	01	00.5
Widow	17 (16.3)	5 (5.2)	22	11.0
Total	104 (100.0)	96 (100.0)	200	100.0

Table1b: Socio-economic Characteristics of Study Participants

Variables	Users	Non-Users	Total Percentage (%)	
	F (%)	F (%)	F	(%)
Occupation				
Student	13 (13.0)	15 (15.6)	28	14.0
Civil servant	15 (14.0)	22 (22.9)	37	18.5
Self employed	34 (33.0)	38 (39.6)	72	36.0
House wife	42 (40.0)	21 (21.9)	63	31.5
Total	104 (100.0)	96 (100.0)	200	100.0

The table1 present socio-demographic data of respondents showed that majority 36.5% and 29.2% were elderly both users and non users with age range of 45 and above. About 31.7% of moringa users had secondary while 24% of non users had secondary, respondents that had tertiary education were 20.0% for moringa users and 34.4% for non users, Majority (40.4%) of moringa users were house wives.

Table 2: Health Information of the Respondents

Characteristic	Users		Non-Users		Total Percentage (%)
	F	%	F	%	
Do you have History of Diabetes in your Family?					
Yes	92	(88.5)	81	(84.4)	173 86.5
No	12	(11.5)	15	(15.6)	27 13.5
Total	104	(100.0)	96	(100.0)	200 100.0
What type of Diabetes were you Diagnosed with?					
Type 1	39	(37.5)	57	(59.4)	96 48.0
Type 2	62	(59.6)	36	(37.5)	98 49.0
Gestational diabetes	3	(2.9)	3	(3.1)	6 3.0
Total	104	(100.0)	96	(100.0)	200 100.0
Are you Placed on any Insulin Therapy or Anti-Diabetic Drugs?					
Yes	39	(37.5)	55	(57.3)	94 48.0
No	65	(62.5)	41	(42.7)	106 52.0
Total	104	(100.0)	96	(100.0)	200 100.0
Do you often go for Medical Checkups Regularly?					
Yes	100	(96.2)	90	(94.0)	190 95.0
No	04	(03.8)	06	(06.0)	10 05.0
Total	104	(100.0)	96	(100.0)	200 100.0
Do you Suffer from any Other Nutritional Related Illness?					
Yes	04	(3.8)	10	(10.4)	14 07.0
No	100	(96.2)	86	(89.6)	186 93.0
Total	104	(100.0)	96	(100.0)	200 100.0

Table 2a and b above shows that 88.5% of the respondents that used moringa had history of diabetes in their family while 84.4% of non users had history of diabetes. Majority (96.2%) of moringa users go for medical checkup more often and 93.8% of non users. 3.8% moringa user suffered from other nutritional related diseases, while 10.4% of non users, 96.2% of users were not suffered any nutritional related diseases and 89.6% of non users were also not suffered from nutritional related diseases.

Table 3: Anthropometric characteristics of study participants

Classification	Users F (%)	Non-Users F (%)	Total	Percentage (%)
Underweight (<18.5)	03(02.9)	01(01.0)	04	02.0
Normal (18.5-24.9)	21(20.2)	06(06.3)	27	13.5
Overweight (25-29.9)	36(34.6)	34(35.4)	70	35.0
Obese (≥ 30)	44(42.3)	55(57.3)	99	49.5
Total	104 (100.0)	96 (100.0)	200	100.0

Table 3 above is anthropometric status of respondents, shows that 2.9% of moringa users were underweight, while 1% of non users, 20.2% of users were normal and 6.3% of non users were also normal, about 34.6% of user were overweight, while 35.4 of non users were overweight this shows the high prevalence of overweight, respondents that were obese were 42.3% and 57.3% users and non users.

Table 4: Blood Glucose Level of the respondents

Fasting Blood Sugar	Users F (%)	Non-Users F (%)	Total	Percentage (%)
High (≥ 11 mmol/L)	31(29.8)	46(47.9)	77	38.5
Borderline (7-10 mmol/L)	68(65.4)	46(47.9)	114	57.0
Normal (4-6 mmol/L)	05(04.8)	04(04.2)	09	04.5
Low (≤ 3.9 mmol/L)	00(00.0)	00(00.0)	00	00.0
Total	104(100.0)	96(100.0)	200	100.0

Table 4 above is glucose level of respondents, shows that 29.8% of respondent that were used moringa had high glucose of level with range of ≥ 11 , while

47.9% of non users at this range, about 65.4% of moringa users were at borderline while 47.9% of non users were at borderline, 4.8% of miring users had normal glucose level and 4.2% of non users had normal glucose in respect with glucose range of 4-6 in fasting glucose level measurement.

Table 5: Knowledge and Attitude of the Respondents

Characteristic	Users		Non-Users		Total Percentage (%)	
	F	%	F	%		
Do you consume Moringa						
Yes	104	(100.0)	00	(00.0)	104	52.0
No	00	(00.0)	96	(100.0)	96	48.0
Total	104	(100.0)	96	(100.0)	200	100.0
How Often do you consume Moringa O						
Daily	30	(28.9)	00	(00.0)	30	28.9
Weekly	50	(48.1)	00	(00.0)	50	48.1
Monthly	12	(11.5)	00	(00.0)	12	11.5
Occasionally	12	(11.5)	00	(00.0)	12	11.5
Total	104	(100.0)	00	(00.0)	104	100.0
How do you know Morina Intake Controls your Blood Sugar						
Measuring the sugar level after						
Consumption	80	(76.9)	-	-		
Through sign and symptoms	10	(9.6)	-	-		
Just like that	14	(13.5)	-	-		
Total	104	(100.0)	96	(100.0)	200	100.0
Do you consume any of this Moringa Product?						
Moringa leaves	49	(47.1)	-	-		
Moringa seeds	5	(4.8)	-	-		
Moringa oil	8	(7.7)	-	-		
Moringa juice (liquid extract from the leave						
	42	(40.4)	-	-		
Total	104	(100.0)	96	(100.0)	200	100.0

The table 5 above showed that all of the questions in this section were answered by only users which showed that 98.1% were consumed moringa, 28.8% of the respondents use moringa daily, 48.1% weekly and 11.5% occasionally. 97.1 of the respondents agreed that moringa had effect of controlling blood sugar level while 2.9% were not agreed that. 76.9% knows that measuring the sugar level after consumption of moringa it controls blood sugar level, 40.4% were consumed moringa juice leaves, 47.1% moringa leaves and powder, 4.8% moringa seeds and 7.7% moringa oil.

Table 6: Mean calorie and nutrient intake of respondents

Nutrients	Users	Non users	RDA
Calorie (Kcal)	2550.21±923.650	1658.11±887.806	2950
Protein(g)	93.91±49.350	47.18±22.954	63
Carbohydrate(g)	424.49±168.140	280.10±126.585	265
Fibre(g)	49.12±189.940	26.27±15.206	38
Fat(g)	50.79±39.290	60.11±199.246	20-35
Water(ml)	1342.29±778.290	866.02±399.992	
Vitamin A(µg)	663.85±990.340	755.10±1334.910	1000
Vitamin C(mg)	62.91±123.260	114.47±392.621	65
Thiamin B1(mg)	2.89±1.740	1.61±0.861	1.4
Riboflavin B2(mg)	1.90±1.140	1.07±0.667	1.4
Niacin B3(mg)	28.19±15.830	15.81±8.167	18
Vitamin B6(mg)	1.81±1.050	1.11±0.631	1.9
Folate (µg)	653.64±564.520	322.18±245.560	600
Vitamin B1(µg)2	1.43±3.460	0.91±3.506	2.6
Calcium(mg)	575.86±442.220	383.72±397.301	1,300
Phosphorus(mg)	1429.74±882.850	859.66±517.576	1,250
Sodium(mg)	2720.18±2445.650	1749.77±1532.739	1,500
Potassium(mg)	3238.39±2249.880	2130.23±1944.116	2,600
Zinc(mg)	39.95±180.980	10.06±13.935	12
Iron(mg)	25.15±12.880	162.58±1429.332	27
Magnesium(mg)	454.45±279.680	344.37±212.835	400

(FNB, IOM, NA & DRIs, 2014)

Table 6 above shows the mean energy intake of respondents, mean energy intake of respondents both users and non users 2550.21 and 1658.11 was below the RDA and the mean protein (93.92) moringa users was above RDa while non user 47.18 were below the RDA

Table 7: Association between blood glucose, anthropometry, socio-economic and medical Information of participants

S/N	Correlated variables	Mean ± S.D	S.E Mean	T	Df	r-Value	P-Value	Remark
Users								
1.	Type of Diabetes & Glucose Level	0.09±0.76	0.07	-1.29	103	0.00	0.198	Not significant
2.	Medical Checkup & Glucose Level	0.71±1.33	0.59	-12.39	103	0.094	0.000	Significant
3.	Occupation & BMI	0.15±1.23	0.12	-1.28	103	0.154	0.205	Not significant
4.	Education Level & BMI	0.58±1.29	0.13	-4.56	103	0.146	0.000	Significant
Non Users								
1.	Type of Diabetes & Glucose Level	0.13±0.95	0.98	-1.28	95	0.412	0.202	Not significant
2.	Medical Checkup & Glucose Level	0.50±0.65	0.06	-7.55	95	0.103	0.000	Significant
3.	Occupation & BMI	0.81±1.08	0.11	-7.31	95	0.179	0.000	Significant
4.	Education Level & BMI	0.94±0.11	0.11	-8.55	95	0.274	0.000	Significant

Table 7 above shows the relationship between occupation Body Mass Index for Moringa users which is not significant with significant value of 0.205, while for non users shows the significant difference between occupation and Body Mass

Index, and relationship between education level and Body Mass Index for Moringa user shows 0.000 which is significant, while for None user also is significant. It also shows the significance difference between medical checkup and glucose level for Moringa users, while for non users is also significant, relationship between type of diabetes and glucose level is not significant for Moringa users, while 0.202 which is not significant in relationship between type of diabetes and glucose level for nonusers.

DISCUSSION

This study was conducted among diabetes patient of Moringa users and non users, the study revealed the socio demographic characteristics of respondents which shows that 13.5% of the respondents that use moringa were within the age range of 15-25 years while non moringa users 18.8% were at this age range. moringa users majority (51%) were married while non users majority (50%) were single, 16.3% for moringa users were widowed while 5.2% of non users were widowed, 14.4% for moringa users were civil servant and 22.9% for non users. Majority (40.4%) of moringa users were house wives this in accordance with study carried out by About 88.5% of the respondents that used moringa had history of diabetes in their family while 84.4% of non users had history of diabetes, 37.5% of moringa users had type 1 diabetes, and 62.5% of respondents that use moringa were no on insulin therapy or anti diabetic drug. Majority (96.2%) of moringa users go for medical checkup more often and 93.8% of non users. 3.8% moringa user suffered from other nutritional related diseases

Study shows the high prevalence of overweight and obese this support with poor nutrition habit, 2.9% of moringa users were underweight, while 1% of non users, 20.2% of users were normal and 6.3% of non users were also normal, about 34.6% of user were overweight, while 35.4% of non users were overweight, obese were 42.3% and 57.3% [McDowell *et al.*, 2013], users and non users is cause as a result of high glucose level which shows that 29.8% of respondent that were used moringa had high glucose of level with range of ≥ 11 , while 47.9% of non users at this range, about 65.4% of moringa users were at borderline while 47.9% of non users were at borderline, 4.8% of miring users had normal glucose level and 4.2% of non users had normal glucose in respect with glucose range of 4-6 in fasting glucose level measurement [Saadi *et al.*, 2015].

Knowledge and attitude of respondents on moringa shows that 98.1% were consumed moringa, 28.8% of the respondents use moringa daily, 48.1% weekly and 11.5% occasionally. 97.1 of the respondents agreed that moringa had effect of controlling blood sugar level while 2.9% were not agreed that. 76.9% knows that measuring the sugar level after consumption of moringa it controls blood sugar level. It also revealed that the respondent consumed the different product of moringa oleifera such as the moringa leave, moringa oil, moringa seeds and moringa juice extracted from the leave, 40.4% were consumed moringa juice leaves, 47.1% moringa leaves and powder, 4.8% moringa seeds and 7.7% moringa oil also in contrary to study conducted by [Olugbemi *et al.*, 2015] similar to the study [Estrella *et al.*, 2013] who revealed that people living with poverty may be at risk of inadequate nutritional status due to poor quality consumption of foods rich in adequate nutrients and the quantity of food consumed by them.

CONCLUSIONS

Moringa oleifera is a plant with many benefits for humans medicinally and economically. Its promotion could help to combat the burden of chronic non-communicable diseases such as diabetes mellitus *Moringa oleifera* is well known and consume ; its leaf is the highest part consumed and consumption pattern prevalent among diabetics. Its nutritional and medicinal benefits are known, but it is consumed most for its medicinal benefit as a blood glucose modifier in managing diabetes. However, consuming *Moringa oleifera* without dosage can pose a negative effect, it would be necessary to conduct clinical trials among the diabetics in developing countries.

CONFLICT OF INTEREST There is no conflict of interest among authors.

References

- Barichella, M.; Pezzoli, G.; Faierman, S.A.; Raspini, B.; Rimoldi, M.; Cassani, E.; Bertoli, S.; Battezzati, A.; Leone, A.; Iorio, L.; et al. Nutritional characterisation of Zambian Moringa oleifera: Acceptability and safety of short-term daily supplementation in a group of malnourished girls. *Int. J. Food. Sci. Nutr.* 2018, 1–9.

- Estrella, M.C.P., Mantaring, J.B.V., David, G.Z., 2013. A double blind, randomised controlled trial on the use of malunggay (*Moringa oleifera*) for augmentation of the volume of breast milk among non-nursing mothers of preterm infants. *Philippine Journal of Pediatric* 49, 3-6.
- Fatoumata, B.A., Mamadou-Saïdou, B.A.H., Mohamet-SENE, Joseph K. S., Modou, M.G. and El Hadji M.B.A. Antidiabetic properties of *Moringa oleifera*: A review of the literature. *Journal of Diabetes and Endocrinology*, 2020; 11(1): 18-29.
- Gupta, R.; Mathur, M.; Bajaj, V.K.; Katariya, P.; Yadav, S.; Kamal, R.; Gupta, R.S. Evaluation of antidiabetic and antioxidant activity of *Moringa oleifera* in experimental diabetes. *J. Diabetes* 2012, 4, 164–171.
- Leone, A.; Spada, A.; Battezzati, A.; Schiraldi, A.; Aristil, J.; Bertoli, S. Cultivation, genetic, ethnopharmacology, phytochemistry and pharmacology of *Moringa oleifera* leaves: An overview. *Int. J. Mol. Sci.* 2015, 16, 12791–12835.
- McDowell, M. A., Fryar, C. D., Ogden, C. L., Flegal, K. M. 2013. Anthropometric reference data for children and adults: United States, 2010-2013. *National Health Statistics Report*. 10 (October): 1-45.
- Ntila, S.; Ndhkala, A.R.; Kolanisi, U.; Abdelgadir, H.; Siwela, M. Acceptability of a moringa-added complementary soft porridge to caregivers in Hammanskraal, Gauteng province and Lebowakgomo, Limpopo province, South Africa. *S. Afr. J. Clin. Nutr.* 2018.
- Olayaki, L.A.; Irekpita, J.E.; Yakubu, M.T.; Ojo, O.O. Methanolic extract of *Moringa oleifera* leaves improves glucose tolerance, glycogen synthesis and lipid metabolism in alloxan-induced diabetic rats. *J. Basic Clin. Physiol. Pharmacol.* 2015, 26, 585–593.
- Olugbemi, T.S., Mutayoba, S.K., Lekule, F.P., 2014. Effect of *Moringa* (*Moringa oleifera*) inclusion in Cassa based diets fed to broiler chickens. *International Journal of Poultry Science* 9, 363-367.

Popoola, J.O.; Obembe, O.O. Local knowledge, use pattern and geographical distribution of *Moringa oleifera* Lam. (Moringaceae) in Nigeria. *J. Ethnopharmacol.* 2013, 150, 682–691.

Saadi H, Carruthers SG, Nagelkerke N, Al-Maskari F, Afandi B, Reed R, Lukic M, Nicholls MG, Kazam E, Algawi K, Al-Kaabi J et al. Prevalence of diabetes mellitus and its complications in a population-based sample in Al-Ain, United Arab Emirates. *Diabetes Res Clin Pract.* 2015;78(3):369–377.

Tadera,K.;Minami,Y.; Takamatsu,K.;Matsuoka, T. Inhibition of alpha-glucosidase and alpha-amylase by flavonoids. *J. Nutr. Sci. Vitaminol. (Tokyo)* 2006, 52, 149–153.