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EFFECT OF *MORINGA OLEIFERA* ON LIPID PROFILE, BLOOD PRESSURE AND BODY MASS INDEX IN HUMAN

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ABSTRACT

Background and Aim: In recent years, *Moringa oleifera* have become a subject of interest because of its characteristics, which are beneficial to human health. In this study, the effect of *Moringa oleifera* on Lipid Profile, Blood Pressure and Body Mass Index was investigated. **Method:** 16 human subjects were randomly divided into two groups, viz group 1 were given 0.03g/kg bw of *Moringa oleifera* (powdered) and group 2 were given 0.07g/kg bw of *Moringa oleifera* (powdered). The study was conducted for a period of 15 days. The blood pressure, body weight and height were measured on day 1, day 7 and day 15. The changes in lipid profile, blood pressure and body mass index were measured and the results were compared statistically, using the student T- test. **Results**: The lipid profile component Low density lipoprotein (LDL), High density lipoprotein (HDL), Total cholesterol and Triglycerides, respectively, showed no significance ($P<0.05$). The blood pressure slightly decreased from 132.57±3.33mmHg to 127.71±3.75mmHg and 129.29±4.76mmHg on day 7 and day 15 respectively for group 1, from 131.56±2.90mmHg to 131.44± 2.60mmHg and 129.67±2.65mmHg on day 7 and day 15 respectively for group 2. The body mass index also slightly decreased from 27.09±1.46kg/m^2 to 26.46±1.52 kg/m^2 and to 26.03±1.42kg/m^2 on day 7 and day 15 respectively for group 1, from 26.02±0.60kg/m^2 to 25.45±0.61kg/m^2 and 25.18±0.63kg/m^2 on day 7 and day 15 respectively for group 2. These were not statistically significant at $p< 0.05$. **Conclusion:** *Moringa oleifera* does not have a significant effect on lipid profile; and there were non-statistically significant drops in the level of blood pressure and body mass index at the end of the 14 days period of this study in normal human subjects.

KEYWORDS: *Moringa oleifera, Lipid Profile Level, Blood Pressure, Body Mass Index.*

INTRODUCTION

Plasma lipid elevation has been of great concern to clinicians because of its potential health complication. Hyperlipidemia has been implicated in many disease conditions like arteriosclerosis, hypertension, obesity, diabetes mellitus, stroke, cancer and other illnesses. Because of the associated morbidities and mortalities, various lowering agents have been employed to reduce this risk. Pharmacological and non-pharmacological agents have been in the limelight in the past few decades. The pharmacological agents commonly used include statins, carnitine, fibrates, cholesterol absorption inhibitors, nicotinic acid derivatives or bile acid sequestrants. The non-pharmacological agents include plants such as Moringa oleifera.

The use of *Moringa oleifera*, especially as supplements in food in the recent times is being popularized because of its various benefits that have been observed. Many of these useful effects have been supported with empirical findings using animals like rat, rabbit etc. However, the theoretical import of these benefits, as to its equal benefits to man, has not been well studied. As a result of paucity of empirical evidence to justify these claimed myriads of benefits, this study was carried out.

Moringa oleifera belongs to the monogeneric family Moringaceae and it is one of the best known, most widely distributed and naturalized species.[1] It is popularly known as drumstick or horse radish in English. It has numerous medicinal uses, and any parts of this plant *i.e.*, leaves, immature pods, flowers and fruits are edible and are used as a highly nutritive vegetable in many countries.[2] This plant was well known to the ancient world, but only recently, it has been rediscovered as a multipurpose tree with a tremendous variety of potential uses. The leaves have been reported to be a rich source of β-carotene, protein, vitamin C, calcium and potassium and act as a good source of natural antioxidant due to the presence of ascorbic acid, flavonoids, phenolics and carotenoids. *M. oleifera* contains nitrile mustard oil glycosides and thiocarbamate glycosides which are anti hypertensive and are very rare in nature.[3] Moringa leaves have been reported to exhibit strong

antioxidant property expressed in terms of free radical scavenging activity and reducing power.[4] Niazimicin, a compound from the leaves has been proposed to be a potent chemoprotective agent in chemical carcinogenesis[5] and Niazimicin (9+10), a thiocarbamate from the leaves of *M. oleifera*, exhibits inhibition of tumour promoter induced Epstein-Barr virus activation.[6] Leaves were found to contain lipid lowering activity in the serum of high fat diet fed rats which may be attributed to the presence of β – sitosterol, hepatoprotective activity and found to preserve and enhance the process of spermatogenesis in mice.[7] The aqueous extract of leaves of *M. oleifera* has shown to lower the blood sugar in diabetic rats.[8] The fresh leaf juice was found to inhibit the growth of microorganisms, staphylococcus aureus and Pseudomonas aeruginosa, which are pathogenic to humans.[9]

Lipid profile is also called lipid panel, it is a panel of blood tests that serves as initial broad medical screening tool for abnormalities in lipids, such as cholesterol and triglycerides. The result of this test can determine certain genetic disorder and can determine approximate risk for cardiovascular disease, certain forms of pancreatitis and other disease.[10] The component of lipid profile include; Low density lipoprotein (LDL), High density lipoprotein (HDL), Triglycerides, Total cholesterol and Very low density lipoprotein (VLDL).[11] This is valuable for detecting genetic diseases such as familial hypercholesterolemia that can be lither, if not treated early.

Blood pressure refers to the force of blood exerted against the walls of blood vessels, especially the arteries, as the heart pumps blood to the rest of the body. It plays a vital role in the way the heart delivers fresh blood, containing all the oxygen and nutrients required from the heart to all the blood vessels throughout the body. It varies with the strength of the heartbeat, the elasticity of the arterial walls, the volume and viscosity of the blood, and a person's health, age, and physical condition**.** Blood pressure is expressed in units called "millimetres of mercury" (mmHg). There are two measurements of arterial pressure: systolic blood pressure and diastolic blood pressure. Systolic blood pressure (SBP), the higher of the two numbers, is the maximum arterial pressure when the heart contracts or beats. Diastolic blood pressure (DBP) is the minimum arterial pressure when the heart relaxes between heartbeats. Blood pressure readings are expressed as systolic pressure over diastolic pressure. For example, a blood pressure measurement of 120/80 mm Hg means that systolic blood pressure is 120 mm Hg and diastolic pressure is 80 mm Hg.[12] Normal Range: 90/60 -140/90 mm Hg.

Body mass index (BMI) or Quetelet index is a measure for human body shape based on an individual's mass and height. It was devised between 1830 and 1850 by the Belgian polymath Adolph Quetelet during the course of developing social physics.[13] It is defined as the individual's body mass divided by the square of their height, with the value universally being given in units of kg/m^2.

MATERIALS AND METHODOLOGY

Subjects; 16 Subjects: Non academic staff of both sexes of Bingham University, Karu, Nasarrawa State, Nigeria

Materials;

- Plain serum bottles
- 5ml syringes
- Tourniquet
- Cotton wool
- Methylated spirit
- Hand gloves
- Rubber cups
- Spoons
- Sugar
- Selectra analyzer
- Electrical weighing scale
- Automatic Blood Pressure monitor (Omron)
- Weighing Balance
- Measuring tape
- Pap (*akamu*)
- *Moringa oleifera* powder purchased from No 11B, Sam Aleno Wyse FRSC Estate, Masaka Nasarawa State, Nigeria

Methodology

Sampling method

The 16 subjects used were chosen consecutively. A verbal consent was gotten from each of them prior to the study. The method was explained to them clearly before the study began.

Collection of blood samples

On the first day of the research 5.0ml of blood was collected from each subject via venipuncture at the dorsum of the wrist region, prior to this; the dorsum of each subject was cleaned with cotton wool that is dipped into the methylated spirit. The blood samples were immediately emptied into the plain serum bottles. This was also done on the 15th day of the research (the day after the last day).

Lipid profile test

Blood samples gotten were taken to Defence Headquarters Medical Centre, Abacha Barracks, Abuja, Nigeria for test using selectra analyzer. Results were gotten after two days. On the 15th day, blood samples were taken again. These was immediately taken to the same clinic (Defence Headquarters Medical Centre, Abacha Barracks, Abuja, Nigeria) for analysis, results were gotten after two days.

Measurement of blood pressure

Each of the subjects was asked to sit comfortably in an upright position with a relaxed state of mind, the left arm was used for the measurement, the cuff of the automatic blood pressure monitor was wrapped around arm, the

monitor was switched on, the blood pressure was measured automatically and the result was recorded.

Measurement of weight
The weight of each subject was measured using a weighing balance, the weighing balance was placed on a levelled ground and each subject was asked to stand on the weighing balance without their shoes. The weight was gotten and recorded.

Measurement of height
Each subject was asked to stand straight by a pole; the individual height was marked at the point of the head using a pencil. A measuring tape was used to measure the point down to the ground and the result was recorded.

Experimental design
The subjects (16) were used as the baseline of the study and were randomly divided into two groups (n=2) as follows:
Group One (8) (low dose group): subjects received 0.03g/kg body weight of *Moringa oleifera* (powdered)
Group Two (8) (high dose group): subjects received 0.07g/kg body weight of *Moringa oleifera* (powdered).

Experimental procedures are
*Powdered leaves of *Moringa oleifera* were purchased from No 11B, Sam Aleno Wyse FRSC Estate, Masaka Nasarawa State, Nigeria. They were measured using the electric kitchen scale into two groups, ie 0.03g/kg body weight and 0.07g/kg body weight.

*Subjects converged to the pap stand at 8 am; the experimental procedure was explained to them. 5.0ml of blood was taken from the first subject using the 5.0ml syringes via venipuncture. Prior to this, the dorsum of the wrist region was sterilized using cotton wool that was dipped in methylated spirit. The blood sample was immediately transferred to the plain serum bottles and labelled carefully. This was done on all the subjects, with the blood samples labelled accordingly; they were then taken to Defense Headquarters Medical Centre, Abacha Barracks, Abuja, Nigeria for analysis. Results were gotten after two days.
*Group one (low dose group) received 0.03g/kg body weight of *Moringa oleifera*. Subjects took it with pap (*akamu*) to improve their tolerance to it. Group two subjects received 0.07g/kg body weight of *Moringa oleifera*, subjects also took it with pap. This was done every day at 8 am for the period of 14 days.

*5.0ml of blood was taken from each subject again on day 15. The same procedure was repeated as before. The clearly labelled plain serum bottles containing blood samples were taken to Defense Headquarters Medical Centre, Abacha Barracks, Abuja, Nigeria for analysis. Results were gotten two days later and recorded.
*The blood pressure of each subject was measured at day 0, day 7 and day 15 of the study.

*The body weight of each subject was measured also at day 0, day 7, and day 15, the height was measured on day 0 only.

Statistical analysis
The data was analysed using Microsoft excel 2007(Microsoft corporation, USA). All the values were presented as mean ± standard error of mean (SEM) for 7 subjects in group one and 9 subjects in group two. The differences between the mean were statistically analysed with paired sample T-test and a p-value of < 0.05 (95% confidence interval).

Ethical Committee Approval
The approval of Ethical Committee of the College of Medicine, Bingham University was gotten before the commencement of research.

RESULTS
The findings obtained from the effect of *Moringa oleifera* on lipid profile, blood pressure and body mass index.

Table 1: showing Effect of *Moringa Oleifera* on LDL (mmol/l)

Dose	Before	After
Group 1 (0.03g/kg bw)	2.33±0.12	2.47±0.16
Group 2 (0.07g/kg bw)	2.74±0.34	2.74±0.26

Table 2: showing Effect of *Moringa Oleifera* on Total Cholesterol (mmol/l)

Dose	Before	After
Group 1 (0.03g/kg bw)	3.8±0.12	4.27±0.13
Group 2 (0.07g/kg bw)	3.94±0.41	4.16±0.22

Table 3: showing Effect of *Moringa Oleifera* on HDL (mmol/l)

Dose	Before	After
Group 1 (0.03g/kg bw)	1.24±0.10	1.3±0.122
Group 2 (0.07g/kg bw)	1.12±0.05	1.13±0.07

Table 4: showing Effect of *Moringa Oleifera* on Triglyceride (mmol/l)

Dose	Before	After
Group 1 (0.03g/kg bw)	1.07±0.16	1.16±0.14
Group 2 (0.07g/kg bw)	1.27±0.11	1.36±0.11

Data are presented as mean ± standard error of mean (SEM).
Before = Means lipid profile before *Moringa oleifera* was administered
After = Means lipid profile after *Moringa oleifera* was administered

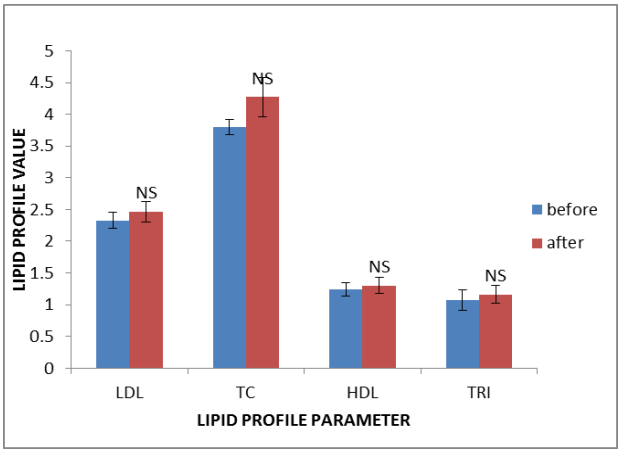

Fig 1: Showing effect of 0.03g/kg bw *Moringa Oleifera* on lipid profile. All values are expressed as mean± SEM, p<0.05.

NS- not significant.

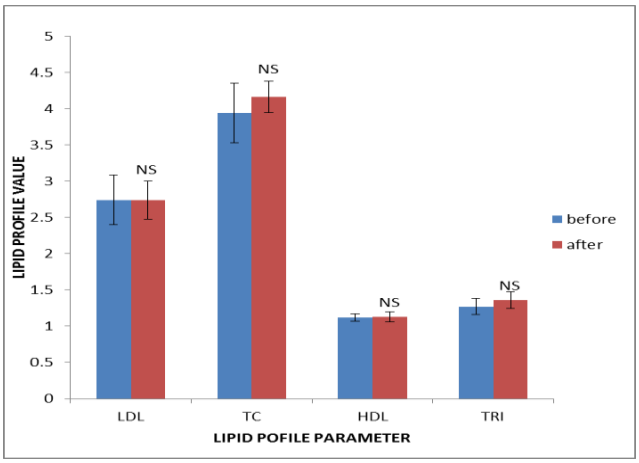

Fig 2: showing effect of 0.07g/kg bw *Moringa oleifera* on lipid profile. All values are expressed as mean± SEM, p<0.05.

NS- not significant.

Table 5: showing Effect of *Moringa Oleifera* on Systolic Blood Pressure (mmHg)

Dose	Day 1	Day 7	Day 15
Group 1 (0.03g/kg bw)	132.57±3.33	127.71±3.75	129.29±4.76
Group 2 (0.07g/kg bw)	131.56±2.90	131.44±2.60	129.67±2.65

Table 6: showing Effect of *Moringa Oleifera* on Diastolic Blood Pressure (mmHg)

Dose	Day 1	Day 7	Day 15
Group 1 (0.03g/kg bw)	76.71±1.85	82.43±3.64	79.28±4.13
Group 2 (0.07g/kg bw)	79.22±1.79	82.44±2.39	78.22±2.03

Table 7: showing Effect of *Moringa Oleifera* on Pulse Pressure (mmHg)

Dose	Day 1	Day 7	Day 15
Group 1 (0.03g/kg bw)	70.71±3.78	73.71±2.09	68.57±3.97
Group 2 (0.07g/kg bw)	71.89±3.01	72.67±2.99	73.67±3.54

Table 8: showing Effect of *Moringa Oleifera* on Body Mass Index (kg/m^2)

Dose	Day 1	Day 7	Day 15
Group 1 (0.03g/kg bw)	27.09±1.46	26.46±1.52	26.03±1.42
Group 2 (0.07g/kg bw)	26.02±0.60	25.45±0.61	25.18±0.63

Data are presented as mean ± standard error of mean (SEM).
Day 0 = Mean blood pressure and body mass index before *Moringa oleifera*.
Days 7, 15 = mean blood pressure and body mass index after *Moringa oleifera*.

Effect of Moringa oleifera on low density lipoprotein
The low density lipoprotein, before the administration of moringa oleifera was 2.33±0.12mmol/l, after administration, it rose to 2.47±0.16mmol/l, which was not significant at p< 0.05 for group 1(0.03g/kg bw). For group 2 (0.07g/kg bw), the values remained almost the same before and after Moringa oleifera, which was 2.74±0.34mmol/l and 2.74±0.26mmol/l respectively. This was not significant at p< 0.05.

Effect of Moringa oleifera on total cholesterol
The mean total cholesterol in group 1 and 2 rose from 3.8±0.12mmol/l to 4.27±0.13mmol/l, 3.94±0.41mmol/l to 4.16±0.22mmol/l respectively, which was not significant at p< 0.05.

Effect of Moringa oleifera on high density lipoprotein
In both group 1 and 2, there was no significant increase in mean high density lipoprotein at p< 0.05 from 1.24±0.10 to 1.3±0.12 and 1.12±0.05 to 1.13±0.07 respectively.

Effect of Moringa oleifera on triglycerides
The mean triglycerides for group 1 and 2 rose from 1.07±0.16mmol/l to 1.16±0.14mmol/l and 1.27±0.11mmol/l to 1.36± 0.11 respectively. This was not significant at p< 0.05.

Effect of Moringa oleifera on systolic blood pressure
In group 1, there was no significant reduction at p<0.05 in the mean systolic blood pressure from 132.57±3.33mmHg to 127.71±3.75mmHg (on day 7) to 129.29±4.76mmHg (on day 15). For group 2, there was no significant reduction from 131.56±2.90mmHg to

131.44±2.60mmHg (on day 7) to 129.67±2.65mmHg (on day 15).

Effect of Moringa oleifera on diastolic blood pressure
In group 1, there was no significant change at p< 0.05 in the mean diastolic blood pressure from 76.71±1.85mmHg to 82.43±3.64 mmHg (on day 7) to 79.28±4.13mmHg (on day 15). For group 2, there was no significant change from 79.22±1.79mmHg to 82.44±2.39mmHg (on day 7) to 78.22±2.03mmHg (on day 15).

Effect of Moringa oleifera on pulse pressure
In group 1, there was no significant change at p< 0.05 in the mean pulse pressure from 70.71±3.78 to 73.71±2.09 (on day 7) to 68.57±3.97 (on day 15). For group 2, there was no significant change from 71.89±3.01 to 72.67±2.99 (on day 7) to 73.67±3.54 (on day 15).

Effect of Moringa oleifera on body mass index
The mean body mass index reduced from 27.09±1.46kg/m^2 to 26.46±1.52kg/m^2 (on day 7) to 26.03±1.42kg/m^2 (on day 15), for group 1. For group 2, there was also reduction in body mass index from 26.02±0.60kg/m^2 to 25.45±0.61kg/m^2 (on day 7) to 25.18±0.63kg/m^2 (on day 15).

DISCUSSION

The present study examined the hypolipidemic effect of *Moringa oleifera* in human subjects and the effect of *Moringa oleifera* on blood pressure and body mass index in human subjects. *Moringa oleifera* has been reported to have a lipid lowering effect in rats as well as hypotensive effect.[3] *Moringa* leaf juice is known to have a normalizing property on blood pressure.[14], [15] The findings of this study are as discussed below.

Effect of *Moringa oleifera* on Serum Lipids
Drawing from previous research in which rats with induced hyperlipidemia were used, aqueous leaf extract of *Moringa oleifera* demonstrated an ameliorative effect on lipid profile. Decrease in the total cholesterol level, triglyceride, LDL and an increase in HDL cholesterol levels in these rats observed,[16], [17], [18] shows that *Moringa oleifera* leaf has a profound hypolipidemic activity which is attributed to its potential to control the mechanisms involved in lipids elimination from the body. However, findings in this study do not support these observations in normal human subjects. From this study, the total cholesterol level increased from the mean values of 3.8±0.12mmol/l to 4.27±0.13mmol/l, and 3.94±0.41mmol/l to 4.16±0.22mmol/l for groups 1 and 2 respectively. Increment is also noted in each component of the lipid profile. The LDL rose from 2.33±0.12mmol/l to 2.47±0.16 mmol/l, 2.74±0.34mmol/l to 2.74±0.26 mmol/l for groups 1and 2 respectively. Similarly, HDL increased from 1.24±0.10mmol/l to 1.3±0.122 mmol/l, and 1.12±0.10 mmol/l to 1.13±0.07 mmol/l for groups 1 and 2 respectively. Elevation was also seen in the level of triglyceride from the initial value of 1.07±0.16mmol/l to 1.16±0.14 mmol/l for group 1 and from 1.27±0.11 mmol/l to 1.36±0.11mmol/l for group 2. Nevertheless, these values are not significant at p< 0.05. Beneficial effect of *Moringa oleifera* recorded in animal model as seen in other studies may not necessarily translate to similar observation in human subjects. This may be a possible explanation for the discrepancy in the results obtained. Besides, since this study was conducted on human subjects whose lipid profile levels were within the normal or reference range, the lipid lowering effect of *Moringa oleifera* may not be evident. As illustrated by the results of this study, the usefulness of *Moringa oleifera* vis-à-vis treating hyperlipidemia in human subjects remains doubtful.

Effect of *Moringa oleifera* on Blood Pressure
Moringa oleifera has been reported to have a lowering effect on blood pressure.[15] Nitrile and thiocarbamate glycosides present in *Moringa* leaves are known to be the hypotensive agents responsible for this effect.[3] Blood pressure results obtained in this study showed that Moringa oleifera confirms this lowering effect in normotensive individuals. Comparing the mean systolic blood pressure of day 1 and day 7, a fall from 132.57±3.33mmHg and 127.71±3.75mmHg for group one was observed; while for group two, the mean blood pressure decreased from 131.56±2.90mmHg on day 1 to 131.44± 2.60mmHg on the 7. Further decrease was recorded on day 15 to 129.29±4.76mmHg and 129.67±2.65mmHg for groups 1 and 2 in that order. Although, these falls in the mean blood pressure in this study were not significant at p< 0.05, benefit may be higher in the hypertensive subjects. Hence, more studies are needed to test the theoretical import of this finding in the hypertensive subjects.

Effect of *Moringa Oleifera* on Body Mass Index
Body mass index (BMI) result obtained from this study showed a decrease in body weight. After seven days into the study, there was decrease in body weight, from 27.09±1.46kg/m^2 to 26.46±1.52 kg/m^2 and from 26.02±0.60kg/m^2 to 25.45±0.61kg/m^2 for groups 1 and 2 respectively. The last result obtained on day 15 demonstrated a further decrease in body weight to 26.03±1.42kg/m^2 and 25.18±0.63kg/m^2 for group 1 and 2 respectively; although, this was not statistically significant at p< 0.005. Extension of study duration or increasing dose of *moringa* may possibly lead to further reduction in BMI but this was not followed up in this study. If such anticipated decrease in BMI could result with increasing dose and or duration, moringa may be very effective in reversing obesity. Besides, most of the participants were not obese, so it is difficult to evaluate if it will be of greater benefit in the overweight and obese people from this study. Hence, future study is recommended to find out the possible benefit of *Moringa oleifera* in weight maintenance and as treatment for obesity.

CONCLUSION

Moringa oleifera, given at 0.03g/kg body weight and 0.07g/kg body weight, does not have a significant effect on the lipid profile of the human, when administered for 14 days. It does not also effect any statistically significant drop in the level of the blood pressure and body mass index of the normal human subject at the end of the 14 days period of the study. Another research may be required to observe if perhaps a significant effect may be noticed in this regard at higher dosage of Moringa oleifera and/or on obese patients (human subjects).

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