Effects of *Momordica Charantia* (Karela/bitterguord) in Type 2 Diabetic Patients Taking Allopathic Drugs: A pilot study

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ABSTRACT

Background

Momordica charantia is evoloving as supplementary therapy in type 2 diabetes mellitus. Animal studies reveal its anti-diabetic and lipid lowering property. However, clinical studies with human subjects are very few.

Objective

To find out the effects of *Momordica charantia* supplements on glycemic and lipid profile among type 2 diabetes mellitus patients taking allopathic drugs.

Method

A comparative study was conducted in internal medicine department of B P Koirala Institute of Health Sciences, Dharan from July 2015 to May 2016 after ethical clearance. Twenty two uncomplicated type-2 diabetes mellitus patients were enrolled. Group A patients were supplemented with allopathic drug (oral anti-diabetic agents) only and Group B with add on treatment of 200 ml juice of *Momordica charantia* along with allopathic drug daily for ninety days. Fasting, post prandial blood sugar and lipid profile levels were compared between baseline and ninety days post supplementation. Data was collected and entry was done in Statistical Packages for Social Services version 20.0, using independent t test with $p < 0.05$.

Result

Add on treatment with 200 ml of *Momordica charantia* along with anti-diabetic drug daily significantly reduced fasting ($p = < 0.0001$) and post prandial blood sugar ($p =< 0.0001$). Treatment with anti-diabetic drugs only reduced fasting ($p = 0.0008$) and post-prandial blood sugar but the reduction was not significant (($p =0.0001$). There was improvement in lipid profile by both anti-diabetic drugs alone and *Momordica charantia* along with anti-diabetic drug, but it was not significant.

Conclusion

Add on treatment with 200 ml/day juice of *Momordica charantia* is effective in glycaemic control in type-2 diabetes mellitus patients as compared to the allopathic treatment alone.

KEY WORDS

Blood sugar, Momordica charantia, Supplementation

INTRODUCTION

Type 2 Diabetes is becoming more prevalent worldwide; accounting for over 90% of all diabetes cases.[1] International Diabetes Federation (IDF) estimates it to be 700 million by 2045. Almost 374 million people are still at risk of developing type 2 diabetes.[2] In Nepal, it's prevalence in adults is 4.0%.[3]

It is estimated that up to 30 % of patients use herbal products and dietary supplements as complementary and/or alternative medicine to control diabetes and its related complication.[4-7] Biochemical and animal model trials reveal anti-diabetic effects of *Momordica charantia* (MC) (bitter gourd, karela), a popular plant used by the natives of Asia, India, Caribbean, South America and East Africa, but clinical studies with human subjects are scarce.[8-11] This study was conducted to see the effects of MC supplements on glycemic profile and lipid profile in type 2 diabetes mellitus patients taking allopathic drugs.

METHODS

This comparative study was conducted among the patients visiting Outpatient department of Internal Medicine, BP Koirala Institute of Health Sciences, Dharan, Nepal from July 2015 to May 2016. Ethical approval was taken from the Institutional Review Committee of BPKIHS (IRC/566/015).

The study inclusion criteria included physician diagnosed Type II Diabetic patients of age above 30 years at screening, able to take the herbal supplements and can strictly follow dieticians' advice. The exclusion criteria applied were: type 1 diabetic patients, secondary and gestational diabetes, pregnancy, breastfeeding, history of hypoglycemia, any serious or recurrent infection, immunodeficiency or HIV patients, findings of any physical or mental abnormality, which would interfere with or be affected by the study procedure.

Sample size was calculated using the following formula:

$n = 2SD^2 (Z_{\alpha/2} + Z_{\beta})^2/d^2$

$= 2 (17.6)^2 (1.96 + 01.65)^2/(27)$

$=11.07$

$=\sim 12$

Where,

n = sample size

SD = standard deviation of 17.62

$Z\alpha/2 = 1.96$ for 0.05 significance level

$Z\beta = 1.65$ for 95% power

d= difference between mean values (11)

Patients who satisfy the inclusion criteria and consent to participate were informed about the objectives of the study. They were strictly advised to abstain from alcohol, smoking, and heavy carbohydrate diet for seven days prior to the test, till the completion of the study period for which they were assessed individually before enrolling in the study. Declaration of anonymity and confidentiality were made and informed written consent was obtained.

Participants were randomly assigned by the principal investigator into two groups (Group A and Group B) of equal number using random number tablets and assigned identification numbers on recruitment. To minimize potential bias, participating participants were not informed of their study allocation until after they had provided consent. Group A was prescribed only the allopathic drug (anti-diabetic drug) and group B was prescribed allopathic drug (dose adjusted) supplemented with self-administration of 200 ml/day juice of *Momordica charantia* (One medium sized *Momordica charantia* fruit crushed in mixer grinder with water and the resultant passed through tea filter) for 90 days. All the patients were asked to maintain the WHO guidelines for Total Calorie Requirement with a range of 1600-2200 calories per day and physical activity of brisk walking 30-45 mins/day, 5 days a week.13 However no activities were undertaken to increase compliance or adherence.

The development of adverse events were closely monitored and participants were encouraged to report any potential adverse events throughout the study (via phone calls or during the follow ups)

Fasting and postprandial blood glucose, fasting lipid profile (investigations at Central Laboratory Services, BPKIHS) were done upon enrollment, on 7th 15th day, 30th day and 90th day. Descriptive statistics such as mean, standard deviation and percent were calculated, comparative statistical analysis was done using independent t test, with $p < 0.05$.

RESULTS

Twenty two uncomplicated type-2 diabetes mellitus patients were enrolled in this study attending the OPD of Internal Medicine department of BPKIHS, Dharan. Most of the participants 12 (54.54%) were female. The baseline characteristics (Table 1) show standardized distribution of study participants among the two groups i.e. Group A and Group B.

Primary outcome with stable dose of allopathic medicine (oral anti-diabetic agent) in the control group i.e. Group A showed a fall in Fasting Blood Sugar (FBS) and 2 hours Post Prandial Blood Sugar (PPBS). There was no significant change in total cholesterol, serum triglyceride, serum LDL-cholesterol and serum HDL-cholesterol (Table 2).

Add on treatment with 200 ml/day of *Momordica charantia* for 90 days in Group B participants showed significant improvement in glycemic control i.e. fall in FBS and PPBS ($p < 0.05$) (Table 3).

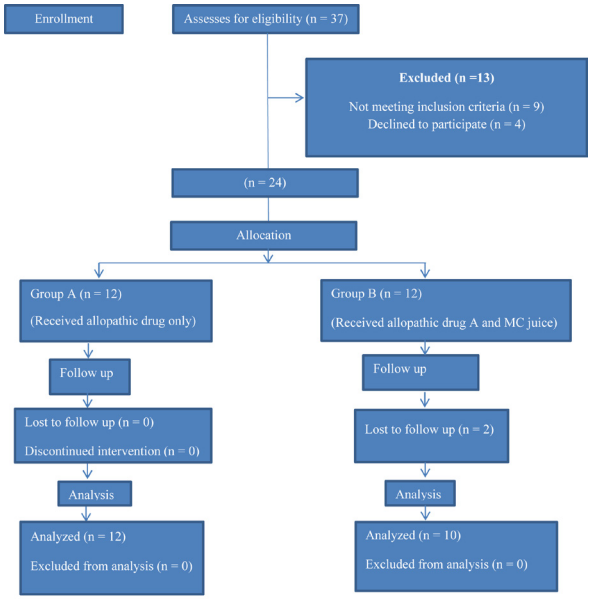

Figure 1. CONSORT Flow Diagram

Table 1. Baseline characteristics of the study population (n=22).

Variable	Group A (Allopathic drugs only) (N=12)	Group B (Allopathic drugs + MC juice) (N=10)
Age(years)	61.9±3.1	57.7±2.9
Weight (kg)	63.5±3.6	58.7±2.3
Height (meter)	1.5±0.02	1.60±0.02
BMI	25.61±0.90	22.75±0.73
Fasting blood sugar (mg/dl)	177.08±19.9	156.9±15.4
Postprandial blood sugar (mg/dl)	236.2±24.9	227.5±33.3
Total serum cholesterol (mg/dl)	201.08±4.7	197.6±19.3
Serum Triglycerides (mg/dl)	159.0±10.04	212.7±22.5
Serum LDL-cholesterol (mg/dl)	114.6±7.09	101.10±12.4
Serum HDL-Cholesterol (mg/dl)	40.1±2.6	41.1±2.8

Table 2. Primary outcome following allopathic medication and MC on FBS, PPBS and serum lipid profile.

Parameters	Groups	Baseline	7 days	15 days	30 days	90 days
Fasting blood sugar (mg/dl)	Drug	177.08 ± 19.9	169.0 ± 25.97	159.7 ± 37.21	157.4 ± 31.28	147.5 ± 21.1
	Drug + MC	156.9 ± 15.4	134.7 ± 23.12	137.0 ± 25.21	124.8 ± 18.31	108.7 ± 13.9
Post prandial blood sugar (mg/dl)	Drug	236.2 ± 24.9	224.5 ± 50.90	216.9 ± 70.12	205.9 ± 62.59	197.7 ± 12.1
	Drug + MC	227.5 ± 33.3	208.1 ± 44.18	205.2 ± 58.33	184.0 ± 21.39	154.5 ± 19.1
Total cholesterol (mg/dl)	Drug	201.08 ± 4.7	200.0 ± 35.20	200.9 ± 41.10	200.0 ± 23.05	197.9 ± 8.4
	Drug + MC	197.6 ± 19.3	196.3 ± 37.71	193.1 ± 38.31	188.5 ± 12.81	184.5 ± 11.1
Serum Triglyceride (mg/dl)	Drug	159.0 ± 10.04	159.3 ± 13.54	158.2 ± 29.42	157.2 ± 21.28	157.8 ± 9.4
	Drug + MC	212.7 ± 22.5	210.9 ± 48.11	208.9 ± 32.81	202.7 ± 31.54	198.9 ± 17.4
Serum LDL –Cholesterol (mg/dl)	Drug	114.6 ± 7.09	114.0 ± 9.42	114.8 ± 23.21	116.5 ± 18.37	114.3 ± 4.31
	Drug + MC	101.10 ± 12.4	99.5 ± 8.13	97.4 ± 8.32	96.4 ± 7.31	93.5 ± 15.2
Serum HDL-Cholesterol (mg/dl)	Drug	40.1 ± 2.6	40.3 ± 5.4	41.1 ± 3.12	40.6 ± 2.91	40.9 ± 11.3
	Drug + MC	41.1 ± 2.8	41.1 ± 8.3	41.0 ± 4.09	41.8 ± 3.15	41.8 ± 10.9

Table 3. Effect of 200 ml/day of momordica charantia with adjusted allopathic drug

***Indicates p < 0.05 (Significant difference as compared to respective baseline levels) by students t-test**

Parameters	Treatment	Allopathy	p- value	Allopathy+ MC	p- value
FBS	Baseline	177.08 ±19.9	0.0008	156.9 ±15.4	< 0.0001*
	On completion	147.5±21.1		108.7±13.9	
PPBS	Baseline	236.2 ± 24.9	0.0001	227.5 ± 33.3	< 0.0001*
	On completion	197.7±12.1		154.5±19.1	
Total cholesterol (mg/dl)	Baseline	201.08 ±4.7	0.2647	197.6 ± 19.3	0.0792
	On completion	197.9±8.4		184.5±11.1	
Serum Triglyceride (mg/dl)	Baseline	159.0±10.04	0.7653	212.7±22.5	0.1424
	On completion	157.8±9.4		198.9±17.4	
Serum LDL –Cholesterol (mg/dl)	Baseline	114.6±7.09	0.901	101.10±12.4	0.2363
	On completion	114.3±4.31		93.5±15.2	
Serum HDL-Cholesterol (mg/dl)	Baseline	40.1±2.6	0.8133	41.1±2.8	0.8463
	On completion	40.9± 11.3		41.8±10.9	

All the patients completed the study without any side effects. FBS, PPBS, Total Serum Cholesterol, Serum triglyceride, Serum LDL-Cholesterol has decreased in both the treatment groups. Magnitude of decrease was directly proportional to the duration of treatment. Serum HDL-Cholesterol increased and the magnitude of increase was directly proportional to the duration of treatment. (Table 2) No significant change was observed following 200 ml/day of *Momordica charantia* treatment on Serum lipid profile.

DISCUSSION

Glycemic and lipid control are the major goals for treating diabetic patient to prevent development of majority of the complications. Despite various drug therapies, adequate glycemic and lipid profile in diabetic patients is still a challenge to many of the health professionals.[2] The notion of food as medicine is a foremost theme in complementary or integrative medicine (CAM).[4] Various extracts of MC are used as dietary supplements as add on or alternative to mainstream medical treatment for relieving symptoms and conditions related to diabetes.[5,7]

In this study, patients taking allopathic drug along with MC have comparatively lower FBS and PPBS than those taking allopathic drug alone by day 90. Similar beneficial effect of MC in blood sugar levels was seen in a study conducted by Hafizur et al. and Tongia et al.[14,15] This could be because of the ability of MC to maintain the structural integrity of pancreatic islets and release of hormones.[14] The hypoglycemic effect of MC could also be due to the active components like Charantin, Vicine and Polypeptide that are known to have structural similarity with human insulin.[16] Peripheral activation of glucose by skeletal muscles and adipose tissue are enhanced by the insulinomimetic action of these compounds, thereby reducing the blood glucose levels.[17] Other potential hypoglycaemic components in MC have been identified as glycosides, saponins, alkaloids, triterpenes, polysaccharides, proteins and sterols.[11] MC can also stimulate insulin secretion from the pancreatic beta cells.[18,19] However, study conducted by John et al. concluded that the glycemic control was not significant.[20] This could be because of the use of dried MC rather than fresh fruit or due to suboptimal dose. Various studies reveal better efficacy for MC when taken in a fresh or juiced form than dried powder.[7]

The lipid lowering effect of MC has been extensively studied in animal models but only few clinical trials have been conducted. This study has revealed MC effective in lowering total cholesterol levels, serum triglycerides and serum LDL - cholesterol levels but no beneficial effect is observed in serum HDL - cholesterol. Similar study conducted by Suchitra et al. reveal MC to be effective in lowering the total cholesterol levels, BMI and blood pressure but no beneficial effect was observed on triglycerides.[17] Several studies have elucidated lipid lowering effects of MC to be multifactorial. Fatty acid oxidation is increased thereby decreasing the body weight, fat mobilizing kinases are mobilized in the liver and skeletal muscle thereby affecting adipocyte differentiation and preventing adipocyte hypertrophy.[21] Studies suggest that MC reduce the process of lipid peroxidation there by preventing the glycation of proteins which could delay the onset of complications in type 2 diabetes mellitus cases.

Patients enrolled in our study took their medication (regularly prescribed anti-diabetic drug) and juice of MC themselves. Thus, the relationship between various confounding factors and the glycemic and lipid control in these patients cannot be overruled in this scenario. So, this study further recommends the need of prospective studies exploring more of the association of glycaemic control, lipid profile control and various confounding factors.

Also, this study could have a better impact if it had a larger sample size. Furthermore, if glycosylated hemoglobin was measured at the end of 90 days it would have omitted the bias regarding temporary food effect in FBS and PPBS.

CONCLUSION

Add-on treatment with *Momordica charantia* (bittergourd) can lower blood sugar profile (both fasting and post prandial) significantly as compared to the allopathic treatment alone. It reduces total serum cholesterol, triglycerides, LDL - cholesterol showing cardio protective effect.

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