

EFFECT OF CYAMOPSIS TETRAGONOLOBA (GUAR) ON LIPID PROFILE IN DIABETIC AND NON-DIABETIC SUBJECTS

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ABSTRACT

Objectives: To compare the effect of Guar fiber in Roasted and cooked vegetable form on lipid profile in diabetic as well as in normal healthy subjects.

Methodology: This study was conducted at Department of Medicine, Sardar Patel Medical College, Bikaner, India on 120 subjects in which 60 were diabetic and 60 non diabetic. Blood samples were withdrawn before and after 15 and 30 days of consumption of 10.0 and 20.0 gm of roasted and cooked guar fiber per day and analyzed for sugar, cholesterol, triglyceride, HDL, LDL and VLDL-cholesterol by standard technique using semi-autoanalyzer.

Results: The Blood sugar, cholesterol, triglyceride, LDL and VLDL showed highly significant results ($t=4.33$ & $p<.001$) after supplementation of roasted guar fiber for 30 days as compare to that of cooked vegetable guar fiber in normal as well as in diabetic subjects in daily routine diet, Blood sugar level ($96.9 \pm 2.49\%$) after 30 days consumption of 20 gm roasted guar fiber per day in normal subjects & in Diabetics ($154.3 \pm 15.38\%$) where as HDL showed no significant change when 20 gm roasted fiber given for 15 days (49.7 ± 7.10), after 30 days range is (55.5 ± 8.16), p value ($p<.05$).

Conclusions: Roasted guar, as compared to cooked guar, significantly reduces Blood sugar, serum cholesterol, triglyceride, LDL and VLDL level not HDL, in both diabetic and non diabetic adults. Roasted guar fiber diet is beneficial for Diabetic as well as Cardiac patients.

Keywords: Diabetes, *Cyamopsis tetragonoloba*, Lipid profile.

INTRODUCTION

Diabetes is the most common of the serious metabolic diseases of humans. A diabetic diet is an essential feature in treatment of diabetes and traditionally this diet has been restricted in carbohydrates¹. Excessive calorie loads lead to adaptive changes which augments the tendency to lipogenesis and storage of body fat. The largest contribution to the triglyceride of Adipose tissue comes from lipogenesis from carbohydrates. However several studies^{2,3} suggested that a high carbohydrate diet might be beneficial in treating some diabetic patients. Diet containing 75 to 85% of calories as carbohydrate had been associated with improved glucose metabolism of normal individuals⁴ and patients with mild diabetes⁵.

Fiber slows the absorption of glucose from the small intestine and lowers the post prandial hyperglycemia. Synthesis, metabolism, and release of cholesterol from the liver may be directly or indirectly altered by plant fibers. Guar gum, a gel forming unabsorbable carbohydrate derived from the cluster bean *Cyamopsis tetragonoloba* was shown to lower the post prandial blood glucose in diabetics⁶.

Soluble fibers have distinct hypocholesterolemic effects in man⁷. Insoluble plant fibers are relatively ineffective in lowering the serum cholesterol. Further studies are required to delineate the effects of plant fibers on the low density lipoprotein and high lipoprotein in cholesterol. High fiber diet causes a reduction of

HDL cholesterol while with low fiber diet HDL cholesterol was increased⁸. High fiber diets are usually accompanied by reduction in total lipid and triglyceride contents. The triglyceride lowering effect of high carbohydrate, a high fiber diet was more evident in patient with hyper triglyceridemia⁹.

Therefore, it was thought worthwhile to investigate the effect of *Cyamopsis tetragonoloba* (Guar) on lipid profile in diabetic and non-diabetic subjects. Guar fiber was given in two form;(1) In dried roasted form and (2) In cooked vegetable form.

METHODOLOGY

The present follow up study was conducted on 120 subjects aged between 25 to 65 years. They were randomly selected irrespective of their caste and creed. Detailed history was taken to exclude any major illness likely to affect lipid profile levels. The subjects having history of drug intake, radiation and any infection during the study were excluded from the present study. The subjects were divided into two groups: 60 Normal Control group and 60 Study group (Diabetic Subjects).

The follow up study was conducted in both the aforesaid groups before and after consumption of guar fibers for 30 days and blood samples were taken after interval of 15 days to find out significance of long term use of guar fiber diet.

Each of the groups I and II was further divided into two sub-groups.

Sub-group A (30): using legumes of *Cyamopsis tetragonoloba* (Guar) in roasted form.

Sub-group B (30): using legumes of *Cyamopsis*

tetragonoloba (Guar) in vegetable cooked form.

Sub-group A was further sub-divided into two groups of A₁ and A₂ each containing 15 subjects/ patients. Sub-sub-group A₁ and A₂ were getting 10 gm and 20 gm dried guar fibers in roasted form per day respectively for 15 days and then further extended upto 30 days, in addition to their normal routine diets. Similarly sub-group B (30) was also sub-divided into two sub-sub-groups B₁ and B₂, each containing 15 subjects/ patients.

Sub-sub-groups B₁ and B₂ were getting 10 gm and 20 gm dried guar fibers in vegetable cooked form per day respectively for 15 days, then extended upto 30 days, in addition to their normal diets.

The samples were analyzed for the following parameters by semi auto analyzer using standardized enzymatic kits of Ranbaxy, are Blood Glucose, Total Cholesterol, HDL- Cholesterol (HDL), Triglyceride (TG), LDL cholesterol (LDL), VLDL cholesterol (VLDL). For Statistical analysis Student's t-test was applied to determine the significance of value ($p < 0.05$).

RESULTS

Table 1 shows blood parameters for normal healthy subjects that is normal control group and Diabetic control subjects and parameters represent Mean and SD along with p value which show highly significant $p < .001$ in Diabetic control subjects.

After consumption of 20 gm roasted guar fiber for 30 days Blood glucose, Total Cholesterol & LDL Cholesterol shows highly significant results ,HDL Cholesterol, VLDL Cholesterol & Triglyceride shows less significant (Table 2).

Table 1: Blood Parameters (Mg%) In Normal Healthy Control and Control Diabetic Subjects

Parameters	Normal Control	Diabetic Subjects	p-value
	Mean \pm sd	Mean \pm sd	
Blood Glucose	98.2 \pm 7.40	209.5 \pm 34.60	<0.001
Total Cholesterol	190.1 \pm 18.49	250.9 \pm 36.20	<0.001
Triglyceride	123.9 \pm 19.66	219.1 \pm 38.27	<0.001
HDL- Cholesterol	48.4 \pm 6.69	29.8 \pm 5.72	<0.001
LDL- Cholesterol	117.0 \pm 18.59	177.3 \pm 38.93	<0.001
VLDL- Cholesterol	24.8 \pm 2.55	43.8 \pm 7.73	<0.001

Table 2: Blood Parameters (Mg%) in Normal Healthy Subjects Before and after Consumption Of 10.0 and 20.0 GM Roasted Guar Fiber per Day For 15 and 30 Days (Mean ± SD)

Parameters	10.0 gm COOKED GUAR FIBER PER DAY					20.0 gm COOKED GUAR FIBER PER DAY				
	Before Consumption	15 Days After Consumption	p-value	30 Days After Consumption	p-value	Before Consumption	15 Days After Consumption	p-value	30 Days After Consumption	p-value
Blood Glucose	92.5±7.00	87.7 ± 7.20	<0.1	86.3 ± 6.00	<0.05	103.7 ± 5.53	99.0 ± 3.53	<0.01	96.9 ± 2.49	<0.001
Total Cholesterol	192.8±21.60	171.2 ± 9.95	<0.01	166.4±17.66	<0.01	199.7 ± 21.56	178.4 ± 18.40	<0.01	171.4 ± 17.53	<0.001
Triglyceride	121.5±21.48	105.5 ± 7.76	<0.05	104.0±17.40	<0.05	123.2 ± 18.20	108.6 ± 16.78	<0.05	106.8 ± 15.97	<0.05
HDL-Cholesterol	55.2 ± 7.56	57.3 ± 7.84	NS	58.6 ± 8.10	NS	49.7 ± 7.10	53.5 ± 7.56	NS	55.5±8.16	<0.05
LDL-Cholesterol	113.4 ± 20.04	92.7±19.12	<0.01	87.0 ± 18.92	<0.001	125.3 ± 21.66	103.3 ± 19.08	<0.01	94.8 ± 18.96	<0.001
VLDL-Cholesterol	24.3±4.29	21.2 ± 3.55	<0.05	20.8±3.48	<0.05	24.7 ± 3.96	21.7 ± 3.38	<0.05	21.1±3.18	<0.05

Table 3: Blood Parameters (mg%) in Normal Healthy Subjects Before and after Consumption of 10.0 and 20.0 gm Cooked Guar Fiber per Day For 15 and 30 Days (Mean ± SD)

Parameters	10.0 gm COOKED GUAR FIBER PER DAY					20.0 gm COOKED GUAR FIBER PER DAY				
	Before Consumption	15 Days After Consumption	p-value	30 Days After Consumption	p-value	Before Consumption	15 Days After Consumption	p-value	30 Days After Consumption	p-value
Blood Glucose	97.0 ± 7.12	93.6 ± 5.69	NS	91.4 ± 4.65	<0.05	99.5 ± 6.34	93.4 ± 5.66	<0.01	90.6 ± 5.12	<0.001
Total Cholesterol	182.8 ± 14.1	167.9 ± 12.80	<0.01	165.2 ± 12.46	<0.01	185.3 ± 8.36	173.0 ± 12.22	<0.01	170.9 ± 10.61	<0.001
Triglyceride	121.0 ± 23.8	104.7 ± 21.16	<0.1	101.9 ± 20.00	<0.05	129.9 ± 18.47	114.9 ± 17.42	<0.05	113.5 ± 16.98	<0.05
HDL-Cholesterol	45.4 ± 10.1	47.8 ± 10.8	NS	49.7 ± 11.64	NS	43.2 ± 11.88	48.7 ± 12.56	Ns	49.6 ± 13.24	NS
LDL-Cholesterol	113.2 ± 15.7	99.2 ± 11.2	<0.01	95.1 ± 14.48	NS	116.1 ± 16.0	101.4 ± 12.44	<0.01	98.6 ± 13.14	<0.01
VLDL-Cholesterol	24.2 ± 4.39	20.9 ± 4.08	<0.05	20.4 ± 3.98	<0.05	26.0 ± 4.36	22.9 ± 3.45	<0.05	22.7 ± 3.28	<0.05

After consumption of 20 gm cooked Guar fiber for 30 days Blood Glucose, Total Cholesterol shows highly significant results, LDL Cholesterol significant, Triglyceride & VLDL cholesterol less significant, HDL Cholesterol no significant result

(Table 3).

In Diabetic subjects after consumption of 20 gm Roasted Guar fiber for 30 days Blood Glucose, Cholesterol & LDL Cholesterol shows highly significant result & Triglyceride, HDL

Table 4: Blood Parameters (Mg%) in Diabetic Subjects before and after Consumption of 10.0 and 20.0 Gm Roasted Guar Fiber per Day For 15 and 30 Days (Mean ± Sd)

Parameters	10.0 gm COOKED GUAR FIBER PER DAY					20.0 gm COOKED GUAR FIBER PER DAY				
	Before Consumption	15 Days After Consumption	p-value	30 Days After Consumption	p-value	Before Consumption	15 Days After Consumption	p-value	30 Days After Consumption	p-value
Blood Glucose	204.5 ± 37.81	168.2 ± 28.66	<0.01	161.4 ± 26.06	<0.01	190.1 ± 24.40	160.4 ± 20.74	<0.01	154.3 ± 15.38	<0.001
Total Cholesterol	237.4 ± 33.15	204.6 ± 28.74	<0.01	196.9 ± 25.34	<0.001	242.6 ± 33.40	206.5 ± 30.24	<0.01	195.8 ± 26.40	<0.001
Triglyceride	221.1 ± 42.11	188.5 ± 35.75	<0.05	185.0 ± 34.88	<0.05	212.0 ± 49.38	173.1 ± 40.79	<0.05	172.7 ± 36.32	<0.05
HDL-Cholesterol	32.3 ± 5.72	36.0 ± 5.84	<0.1	38.2 ± 9.36	<0.05	28.8 ± 5.89	33.2 ± 7.30	<0.1	34.5 ± 8.12	<0.05
LDL-Cholesterol	161.0 ± 30.08	130 ± 26.0	<0.01	121.7 ± 24.24	<0.001	171.4 ± 31.64	138.5 ± 26.20	<0.01	126.8 ± 24.88	<0.001
VLDL-Cholesterol	44.2 ± 8.53	37.7 ± 7.44	<0.05	37.0 ± 6.24	<0.05	42.4 ± 8.23	34.6 ± 7.76	<0.05	34.5 ± 6.98	<0.05

Table 5: Blood Parameters (mg%) in diabetic subjects before and after consumption of 10.0 and 20.0 gm Cooked Guar Fiber per Day for 15 and 30 days (Mean ± SD)

Parameters	10.0 gm COOKED GUAR FIBER PER DAY					20.0 gm COOKED GUAR FIBER PER DAY				
	Before Consumption	15 Days After Consumption	p-value	30 Days After Consumption	p-value	Before Consumption	15 Days After Consumption	p-value	30 Days After Consumption	p-value
Blood Glucose	228.4 ± 23.08	205.8 ± 20.30	<0.01	200.5 ± 19.92	<0.01	215.5 ± 32.3	175.9 ± 29.41	<0.01	166.3 ± 28.55	<0.001
Total Cholesterol	257.1 ± 41.06	217.8 ± 35.60	<0.01	208.6 ± 32.24	<0.01	266.7 ± 26.48	241.1 ± 20.56	<0.01	234.8 ± 17.36	<0.001
Triglyceride	216.6 ± 40.96	188.5 ± 35.80	<0.1	186 ± 34.95	<0.01	226.6 ± 35.84	200.7 ± 30.80	<0.05	197.5 ± 29.26	<0.05
HDL-Cholesterol	29.0 ± 5.07	32.5 ± 6.24	NS	33.6 ± 7.86	<0.1	29.4 ± 4.17	32.5 ± 5.24	<0.1	33.6 ± 6.90	<0.1
LDL-Cholesterol	184.8 ± 38.96	147.6 ± 32.12	<0.01	137.8 ± 28.84	<0.001	192.0 ± 23.60	168 ± 20.20	<0.01	161.7 ± 18.44	<0.001
VLDL-Cholesterol	43.4 ± 7.77	37.7 ± 6.86	<0.05	37.2 ± 5.96	<0.05	45.3 ± 6.81	40.1 ± 5.11	<0.05	39.5 ± 4.95	<0.05

Cholesterol & VLDL Cholesterol shows less significant result (Table 4).

In Diabetic Subjects after consumption of 20 gm Cooked Guar fiber for 30 days Blood

Glucose, Total Cholesterol & LDL Cholesterol shows significant results Triglyceride & VLDL Cholesterol less significant and HDL Cholesterol no significant result (Table 5).

DISCUSSION

Plant fibers influence the absorption and metabolism of triglyceride and fatty acids. High fiber diets are usually accompanied by reduction in total lipid and triglyceride content of liver¹⁰. Thus scanty and diversant reports are available over human population regarding in effect of *Cyamopsis tetragonoloba* (Guar) on carbohydrate and lipid metabolism.

In present study blood sugar level was found to be raised significantly in diabetic subjects as compared to that of normal control. According to Harbas Lal(2000), due to deficiency of insulin in diabetic subjects resulting reduced entry of glucose in body cells and increased glucose release from liver into circulation¹¹.

Similarly, the serum cholesterol level was increased significantly in diabetic patients as compared to that of normal control group, might be due to increased intestinal HMGCoA reductase activity resulting enhance cholesterol synthesis associated with transport of newly synthesized cholesterol from intestine to circulation¹².

The statistical significant increase in serum triglyceride level was observed in diabetic patients as compared to that of control group. Niall reported that increase in serum triglyceride level may be due to insulin deficiency, which increase the free fatty acids (FFA) and decrease the lipoprotein lipase activity in diabetic subjects resulting increase serum triglyceride level¹³.

The serum LDL-cholesterol was found to be increased significantly in diabetic subjects as compared to that of control. According to Donald, might be due to increased synthesis of VLDL precursors or impaired removal of VLDL from LDL, which is a component of LDL, in diabetic subjects. Besides this, hypercholesterolemia might be one of the causes to increase LDL-cholesterol in diabetes mellitus¹⁴.

A significant increase in VLDL-cholesterol in diabetic subjects was noted when compare to that of normal control. It might be due to increased fraction of triglyceride which is a component of VLDL-cholesterol¹⁵.

The serum HDL- cholesterol was reduced in diabetic subjects as compare to that of control. The lowered HDL cholesterol may be due to reduced lipoprotein lipase activity in diabetic subjects, which is responsible for transport of apo-lipoprotein and phospholipids to HDL-cholesterol¹⁶.

An insignificant reduction in blood glucose level was recorded n normal healthy subjects after 15 an 30 days of consumption of 10.0 gm roasted or cooked guar fiber per day as

compared to their respective control groups; while a significant reduction was observed after 15 and 30 days of consumption of 20.0 gm cooked or roasted guar fiber per day¹⁷.

But however, a significant decrease in blood sugar level was observed in diabetic subjects after 15 and 30 days of consumption of either 10 or 20 gm of roasted or cooked guar fiber per day as compared to their respective diabetic control groups⁶.

The reduction in blood sugar level after consumption of guar fiber in normal healthy as well as diabetic subjects might be due to the possibility that guar fiber may inactivate the digestive enzyme leading to decrease absorption of carbohydrate resulting lower the blood sugar level.

However, the reduction in blood sugar level after 15 and 30 days of consumption of 10.0 gm roasted or cooked guar fiber per day was significant in diabetic subjects while insignificant in normal healthy subjects,might be due to the possibility that guar fiber may alter the insulin level in normal control while ineffective in diabetic subjects.

A significant reduction in serum cholesterol concentration was recorded in normal control as well as in diabetic subjects after 15 and 30 days of consumption of 10.0 and 20.0 gm of roasted or cooked guar fiber per day, might be possible that guar fiber may increase the fecal excretion of bile acids and diverts the cholesterol into bile acid synthesis resulting decreased serum cholesterol level¹⁸.

The serum triglyceride level was found to be reduced insignificantly in normal healthy as well as in diabetic subjects after 15 and 30 days of consumption of 10.0 and 20.0 gm of roasted or cooked guar fiber per day. It might be due to the possibility that guar fiber may reduce the absorption of triglyceride and fatty acids; secondly fiber may increase the fecal excretion of fat including fatty acids resulting decreases synthesis of triglycerides¹⁹.

No alteration in serum HDL-cholesterol concentration was recorded in normal healthy as well as in diabetic subjects after 15 and 30 days of consumption of 10.0 and 20.0 gm of roasted or cooked guar fiber per day. A possible explanation for slight increase in HDL-cholesterol in that guar fiber may alter the proportion of cholesterol incorporation into HDL-cholesterol synthesis²⁰.

Statistical significant reduction in serum LDL-cholesterol concentration was recorded in normal healthy as well as in diabetic subjects after 15 and 30 days of consumption of 10.0 and 20.0

gm of roasted or cooked guar fiber per day. It might be possible that guar fiber may cause the depletion of bile acids by fecal excretion, resulting the diversion of cholesterol into bile acid pool and less cholesterol may be available for incorporation into LDL-cholesterol synthesis²¹. Insignificant deviation in serum VLDL-cholesterol concentration was recorded in normal healthy as well as in diabetic subjects after 15 and 30 days of consumption of 10.0 and 20.0 gm of roasted or cooked guar fiber per day. However, a slight reduction in VLDL-cholesterol concentration after consumption of guar fiber might be due to the possibility that guar fiber may decrease the delivery of fatty acids into portal vein which might decrease the synthesis of VLDL-cholesterol from the liver¹⁶.

CONCLUSION AND RECOMMENDATION

The effect of roasted guar fiber supplementation in diets was more beneficial as compare to that of cooked guar fiber in normal as well as in diabetic subjects. It might be possible that cooked guar fiber become partial soluble and digestible resulting its decreased excretion in feces leads to decrease the excretion of unabsorbed carbohydrate and fatty acids and thus become less effective in lowering the blood sugar and lipid profile levels.

Supplementation of roasted guar fiber in daily routine diet is beneficial in lowering the blood sugar and lipid profile except the HDL-cholesterol, in normal healthy as well as in diabetic subjects.

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