WORLD JOURNAL OF PHARMACEUTICAL AND MEDICAL RESEARCH
www.wjpmr.com

POTENTIAL EFFECTS OF FENUGREEK (TRIGONELLA FOENUM GRAECUM L) ON THE BLOOD GLUCOSE, LIPID PROFILE AND MARKER ENZYMES IN THE FRESH WATER FISH CIRRHINUS MRIGALA

Meera Gopi[1], Rosmin M. T.[2] and Pawlin Vasanthi Joseph*[3]

[3]Associate Professor and Head Department of Zoology Nirmala College for Women (Autonomous) Coimbatore-641018 Tamilnadu, India.
[1]Post Graduate Student Department of Zoology Nirmala College for Women (Autonomous) Coimbatore-641018 Tamilnadu, India.
[2]Post Graduate Student Department of Zoology Nirmala College for Women (Autonomous) Coimbatore-641018 Tamilnadu, India.

*Corresponding Author: Pawlin Vasanthi Joseph

Post Graduate Student Department of Zoology Nirmala College for Women (Autonomous) Coimbatore-641018 Tamilnadu, India.

ABSTRACT

Diabetes mellitus is a major public health problem in India. It is a very common health problem across the globe. Diabetes mellitus has a huge impact on the quality of life and on an individual's subjective perception of physical, emotional and social well-being. Fenugreek seeds are a rich source of saponins, flavonoids, choline, carotene, essential oils containing trigonelline and other functional elements. The seeds also contain fiber fenugreekine, a component that may have hypoglycemic activity. The objective of the present work is to study the effects of oral administration of Fenugreek seed powder on the biochemical and enzyme profile of the fish. The experimental set up includes one control and three experimental tubs marked as 1g, 3g and 5g. Fishes in the control were fed with the basal diet whereas the experimental fishes were fed with the basal diet having fenugreek of concentrations of 1, 3, 5g/ 100g of basal feed respectively. The experimental set up was maintained for 45 days. The biochemical and enzyme profile of the fish was estimated. It has been observed that fenugreek seeds have a significant lower glycaemic response in fishes. It can be used to decrease the blood glucose levels in diabetic patients and has the ability to reduce Serum Cholesterol, Triglyceride, LDL and able to raise HDL. Fenugreek given before the meal causes a significant reduction in Glycemic index and is beneficial to Non insulin-dependent diabetes mellitus patients for long term control of their blood glucose levels and prevention of hyperglycaemic related complications

KEYWORDS: Diabetes mellitus, fenugreek, blood glucose, Total cholesterol, Triglycerides, LDL, HDL, Aspartate and Alanine amino transferase.

INTRODUCTION

Diabetes mellitus is a major public health problem in India. It is a very common health problem across the globe. Diabetes mellitus has a huge impact on quality of life. It has an impact on an individual's subjective perception of physical, emotional and social well-being, including both a cognitive component and an emotional component (Vidya *et al.,* 2017).

The risk factors peculiar for developing diabetes among Indians include high familial aggregation, central obesity, insulin resistance and life style changes due to urbanization. Screening for gestational diabetes and impaired glucose tolerance among pregnant women provides a scope for primary prevention of the disease in mothers as well as in their children. The problems of obesity and impaired glucose tolerance (IGT) are not confined to adults alone but children are also increasingly getting affected (Mehta *et al.,* 2009).

Fenugreek (*Trigonella foenum-graecum* L) commonly known as methi is an annual herb belonging to the family Papilionaceae. Fenugreek seeds are a rich source of protein, minerals, vitamins, gum, fiber, alkaloid, flavonoids, saponin and volatile compounds. It is one of the most promising medicinal herbs, known from ancient times and shows antioxidant, anticarcinogenic, antidiabetic, hypocholesteromic, hypoglycemic and lactation induced properties. Recent studies have revealed that fenugreek is a valuable herb having medicinal properties and thus, can be used for preparing different products of medical importance (Fatima, 2018).

Fenugreek seeds are also a rich source of saponins, flavonoids, choline, carotene, essential oils containing

trigonelline and other functional elements (Srinivasan, 2006). The seeds also contain fibre fenugreekine, a component that may have hypoglycemic activity. Lignin, another form of crude fiber, is not a carbohydrate per se, but it is of plant origin and is also indigestible, which prevents the rapid uptake of glucose in the small intestine, slows gastric emptying, aids in blood sugar retention in diabetic patients and may also be effective in the treatment of hypercholesterolemia (Mullaicharam, 2013).

The 4-hydroxyisoleucine component of fenugreek extract may also decrease plasma triglyceride consequently leading to prevention of obesity induced by a high-fat diet. Furthermore some chemical constituents of fenugreek may directly stimulate insulin secretion from ß-cells resulting in reduction of blood sugar (Yanardag *et al.,* 2003).

Subhash *et al*., (2012); Nandini *et al.,* (2015); Arunima *et al.,* (2015) and Majid *et al.,* (2016) examined the effect of indigenous foods (fenugreek, black sesame and bitter cumin) on blood glucose level of Type – 2 diabetic patients and reported that fenugreek powder helps in controlling fasting and postprandial blood glucose level of diabetic patients. Hence fenugreek powder can be used as a substitute to control blood glucose level of type -2 diabetic patients.

Arumugam *et al*., (2017) found that fenugreek is a reducer of glucose and lipid profile in diabetic subjects and they observed that it has produced significant reduction in fasting blood glucose with modulations in the lipid profiles, leading to the conclusion that fenugreek seeds can be used as an adjuvant with oral hypogycaemic agents in reducing hyperglycaemia. The objective of the present work is to study the effects of oral administration of Fenugreek seed powder on the biochemical and enzyme profile of the fish.

MATERIALS AND METHODS

Fishes were purchased from the fishery unit of Aliyar dam, near Pollachi, Coimbatore District, Tamilnadu. The fingerlings ranged from 10 to 12 cm and weighed about 10 – 12 g. They were transported to the lab in oxygenated polythene bags. Fishes were acclimatized in the lab for 10 days. The diet of Bhosale (2010) was followed which includes soybean, groundnut cake and corn flour in the ratio of 2:2:1. The tanks were maintained and kept clean in order to avoid contamination.

The experimental set up includes one control and three experimental tubs marked as 1g, 3g and 5g. Fishes in the control were fed with the basal diet whereas the experimental fishes were fed with the basal diet having fenugreek with the concentration of 1, 3, 5g/ 100g of basal feed respectively. The experimental set up was maintained for 45 days.

Biochemical Parameters
Blood Glucose Determination: Serum blood glucose levels were measured by enzymatic method (Trinder, 1969) by using a Serum glucose kit.

For the estimation of glucose 10 µl of serum were added to 1 ml of working solution in a test tube. The content was mixed and measured after incubation of 15 minutes at 37C° or 30 minutes at 25C°. The absorbance of sample and standard were measured against reagent blank by spectrophotometer at a wavelength of 546 nm.
Calculation: The blood glucose concentration was calculated according to the following Equation:

$$\text{Blood glucose} = \frac{\Delta A \text{ sample} \times \text{standard concentration}}{\Delta A \text{ standard}} \text{ Mg/dL}$$

Standard concentration = 100 mg/dL.

Total serum cholesterol: was done by enzymatic method (Richmond, 1973; Sidel *et al.,* 1983).

For the estimation of total cholesterol 10 µl of serum was added to 1 ml of a working solution in a test tube. The content was mixed and incubated for 5 minutes at 37C° or 10 minutes at 25C°. The absorbance of calibrator sample and standard were measured against reagent blank by spectrophotometer at a wavelength of 546 nm within 60 minutes.

Calculation: The total cholesterol concentration was calculated according to the following Equation

$$\text{Total cholesterol} = \frac{\Delta A \text{ sample} \times \text{standard concentration}}{\Delta A \text{ standard}} \text{ Mg/dL}$$

Standard concentration = 200 mg/dL.

Serum Triglyceride Determination: The serum triglyceride was measured by enzymatic method (Fossati and Prencipe 1982).

For the estimation of serum triglycerides 10 µl of serum was added to 1 ml of the working solution in a test tube. The content was mixed and incubated for 5 minutes at 37C or 10 minutes at 25C. Now read absorbance of sample against reagent blank by spectrophotometer at 546 nm wavelength within 60 minutes.

Calculation: The triglyceride concentration was calculated according to the following Equation:

$$\text{Triglyceride} = \frac{\Delta A \text{ sample} \times \text{standard concentration}}{\Delta A \text{ standard}} \text{ Mg/dL}$$

Determination of High density lipid (HDL) (Friedwald, 1972):

A. Separation of HDL Cholesterol
- Label tubes for appropriate controls and samples.
- Pipette 0.5 ml (500 ul) sample into respective tubes.

- Pipette 0.5 ml (500 ul) reagent into each tube and mix using vortex.
- Centrifuge at 1000-2000g for 10 minutes.

B. HDL Cholesterol Determination
- Label tubes "Blank", "Standard", "Control", "sample", etc.
- Pipette 1.0ml enzymatic cholesterol reagent, prepared according to package inserts instructions, into each tube.
- Pipette 0.05 ml (50 ul) standard or clear supernatants from step #4 above to respective tubes.
- Incubate all tubes for 10 minutes at 37°C.
- Zero spectrophotometer at 500 nm with reagent blank.
- Read and record absorbance of all tubes at 500 nm.

Calculation
Abs. Sample

$$\text{HDL Cholesterol (mg/dl)} = \frac{\text{Abs. Sample}}{\text{Abs. Standard}} \times \text{Conc. of Std.} \times 2$$

Determination of Low density lipid (LDL) (Uddin, 2011):
All reagents except enzyme mix to room temperature prior to assay. Non-haemolyzed serum samples should be used.

1. Sample Preparation: Transfer 20 μL serum into a 1.5-mL centrifuge tube, add 20 μL Precipitation Reagent. Vortex to mix and centrifuge 5 min at 9,500 xg. Carefully remove all remaining supernatant from the pellet. Transfer 40 μL PBS to the pellet and mix by repeated pipetting. Transfer 24 μL mixture into another clean tube, add 96 μL Assay Buffer. Label this tube "LDL". In a third tube, transfer 12 μL serum samples and mix well with 108 μL Assay Buffer. Label this tube "Total". Cholesterol Standard: transfer 5 μL 300 mg/dL cholesterol and mix with 145 μL Assay Buffer. Label this tube "Standard".

2. Assay: Transfer 50 μL Assay Buffer ("Blank"), 50 μL Standard, 50 μL "Total", 50μL "LDL" into wells of a clear flat-bottom 96-well plate. If desired, run assays in duplicate. For each reaction well, mix 55 μL Assay Buffer with 1 μL Enzyme Mix and 1 μL Dye Reagent. Add 50 μL of this Working Reagent to each standard and sample well. Tap plate to mix well. Incubate 30 min at room temperature. Read OD values at 570 nm.

Calculation

$$\text{LDL} = \frac{\text{OD LDL} - \text{OD BLANK}}{\text{OD STANDARD} - \text{OD BLANK}} \times 100 \text{ (mg/dl)}$$

Enzyme study
SGOT (AST)
SGOT activity was estimated by 2,4-DNPH method (Reitman and Francle, 1957).

For the estimation of SGOT, two test tubes were taken and marked as Control (C) and Test (T). To the 'Control' and 'Test' tubes 0.125ml of sample was added, mixed well and incubated at 37 C for 5 minutes. The 0.025 ml of sample was added, mixed well and incubated at 37 C for 60 minutes. To both the test tubes 0.025 ml of Reagent -2 was added, mixed well and allowed to stand at room temperature for 20 minutes. Finally 1.25 ml of solution -1 was added to both the test tubes, mixed well and allowed to stand at room temperature for 10 minutes. The O.D values of 'Control' and 'Test' were measured against distilled water on spectronic – 20D + at 505nm.

Calculation

$$\text{Concentration of Oxaloacetate in test (μg)} = \frac{\text{O.D Test}}{\text{O.D Standard}} \times \frac{\text{Concentration of standard in μg}}{\text{Volume of sample in ml}} \times 1000$$

6.2 SGPT (AST)
SGPT activity was estimated by 2,4-DNPH method (Reitman and Francle, 1957).

For the estimation of SGPT, two test tubes were taken and marked as Control (C) and Test (T). To the 'Control' and 'Test' tubes 0.125ml of sample was added, mixed well and incubated at 37 C for 5 minutes. Then 0.025 ml of sample was added, mixed well and incubated at 37 C for 60 minutes. To both the test tubes 0.025 ml of Reagent -2 was added, mixed well and allowed to stand at room temperature for 20 minutes. Finally 1.25 ml of solution -1 was added to both the test tubes, mixed well and allowed to stand at room temperature for 10 minutes. The O.D values of 'Control' and 'Test' were measured against distilled water on spectronic – 20D + at 505nm.

Calculation

$$\text{Concentration of pyruvate. in test (μg)} = \frac{\text{O.D Test}}{\text{O.D Standard}} \times \frac{\text{Concentration of standard in μg}}{\text{Volume of sample in ml}} \times 1000$$

Statistical Analysis
Mean, Standard Deviation, one way ANOVA, two way ANOVA and DMRT was done for Bio-chemistry and Enzyme studies.

Table 1: Bio-Chemical parameters of the blood of *Cirrhinus mrigala* treated with various concentrations of fenugreek on the 30th day of experimentation.

Sample	Glucose (mg/dl)	Total Cholesterol (mg/dl)	LDL (mg/dl)	HDL (mg/dl)	Triglycerides (mg/dl)
Control	62±0.71**	160±1.14**	86±1.22**	39±2.31**	175±1.22**
T1 (1g)	50±0.70**	154±1.41**	75±0.70**	49±1.57**	150±0.70**
T2 (3g)	40±1.14**	148±1.00**	68±1.00**	51±1.73**	145±1.00**
T3 (5g)	34±0.70**	140±0.70**	56±0.70**	58±1.26**	130±1.41**

Values are Mean ± standard error of the samples of each group; **-significant at P<0.01.

Table 2: One way ANOVA for the Bio-chemical parameters in the blood of *Cirrhinus mrigala* treated with various concentrations of fenugreek on the 30th day of experimentation.

Sample	df	SS	MS	F	P	CV%
Glucose	3	2269.60	487.91	209.11	0.0000**	3.0%
Total Cholesterol	3	643.35	214.45	46.87	0.0000**	1.4%
LDL	3	1703.75	567.91	63.99	0.0000**	4.1%
HDL	3	863.35	287.783	21.22	0.0000**	7.4%
Triglycerides	3	4343.75	1447.916	202.03	0.0000**	1.8%

df - degrees of freedom; **SS** - sum of squares; **MS** - mean square; **F** - F - test; **P** - probability; **CV** – coefficient of variation; ** - significant at P < 0.01 level.

Table 3: Bio-Chemical analysis of the blood of *Cirrhinus mrigala* treated with various concentrations of fenugreek on the 45th day of experimentation.

Sample	Glucose (mg/dl)	Total Cholesterol (mg/dl)	LDL (mg/dl)	HDL (mg/dl)	Triglycerides (mg/dl)
Control	68±0.70**	170±1.30**	90±1.65**	45±0.34**	175±1.22**
T1 (1g)	50±0.70**	162±0.70**	80±0.50**	50±0.62**	160±1.00**
T2 (3g)	48±0.70**	158±1.48**	72±1.35**	55±1.07**	155±0.70**
T3 (5g)	42±1.14**	150±1.14**	62±1.75**	58±0.70**	150±1.00**

Values are Mean ± standard error of the samples of each group; **-significant at P<0.01

Table 4: One way ANOVA for the Bio-chemical analysis of the blood of *Cirrhinus mrigala* treated with various concentrations of fenugreek on the 45th day of experimentation.

Sample	df	SS	MS	F	P	CV%
Glucose	3	1880.00	626.66	254.92	0.0000**	3.0%
Total Cholesterol	3	1040.00	346.66	59.01	0.0000**	1.5%
LDL	3	2120.00	706.66	89.68	0.0000**	3.7%
HDL	3	490.00	163.33	49.12	0.0000**	3.5%
Triglycerides	3	1750.00	583.33	222.22	0.0000**	1.0%

df - degrees of freedom; **SS** - sum of squares; **MS** - mean square; **F** - F - test; **P** - probability; **CV** – coefficient of variation; ** - significant at P < 0.01 level.

Table 5: Two way ANOVA for the Bio-chemical analysis of the blood of *Cirrhinus mrigala* treated with various concentrations of fenugreek.

Sample	df	SS	MS	F	P	CV%
Glucose	7	3374.37	483.05	197.77	0.0000**	3.1%
Total Cholesterol	7	2299.57	328.51	65.45	0.0000**	1.4%
LDL	7	3964.37	566.33	59.88	0.0000**	4.1%
HDL	7	1408.57	201.22	19.85	0.0000**	6.3%
Triglycerides	7	6859.37	979.91	131.12	0.0000**	1.8%

df - degrees of freedom; **SS** - sum of squares; **MS** - mean square; **F** - F - test; **P** - probability; **CV** – coefficient of variation; ** - significant at P < 0.01 level.

Table 6: Estimation of enzyme level of *Cirrhinus mrigala* treated with various concentrations of fenugreek on the 45th day.

Sample	Alanine Amino Transferase (U/L)	Aspartate Amino Transferase (U/L)
Control	35±0.70**	21±0.70**
T1 (1g)	27±0.70**	17±0.70**
T2 (3g)	23±0.70**	13±0.70**
T3 (5g)	21±0.70**	11±0.70**

Values are Mean ± standard error of the samples of each group; **-significant at P<0.01.

Table 7: One way ANOVA for the enzyme analysis on the blood of *Cirrhinus mrigala* treated with various concentrations of fenugreek on the 45th day.

SAMPLE	Df	SS	MS	F	P	CV%
ALT	3	575.00	191.66	76.67	0.0000**	6.0%
AST	3	295.00	98.33	63.78	0.0000**	8.0%

df - degrees of freedom; **SS** - sum of squares; **MS** - mean square; **F** - F - test; **P** - probability; **CV** – coefficient of variation; ** - significant at P < 0.01 level.

RESULTS AND DISCUSSION

Glucose

The mean glucose value of the control on 30th day is (62 ±0.70, P<0.05). There is a significant decrease in all the experimental groups treated with fenugreek on 30th day (50.4±0.70, P<0.05), T2 (40±1.14, P<0.05), T3 (34±0.70, P<0.05).The one way ANOVA for the levels of glucose in the control and experimental is significant at 1% level. The mean glucose value of the control on 45th day is (68±0.70, P<0.05). There is a significant decrease in all the experimental groups treated with fenugreek on 45th day (50±0.70, p<0.05), (48±0.70, P<0.05), (42±1.14, P<0.05).The one way ANOVA for the levels of glucose in the control and experimental is significant at 1% level.

Staub *et al.*, (1921) isolated 4-hydroxyleucine, a novel amino acid from fenugreek seeds, which is not present in mammalian tissues. It is reported that 4-hydroxy leucine simulates insulin secretion through a direct action on pancreatic - cells in experimental animals and in humans.

Subsequently, it has been shown in experimental studies that galactomannan derived from fenugreek seeds has an inhibitory effect on starch digestion. Based on this information, it has been postulated that galactomannan, present in the fenugreek seeds, may be responsible for its hypoglycaemic effect (Raghuram *et al.*, 2005).

Addition of fenugreek to prescribed diets in diabetics decreased the requirement of insulin and oral anti diabetic drugs. It has been reported that the euglycaemia achieved by conventional insulin and oral hypoglycaemic drug treatment could not completely prevent microvascular and neurological complications. It has been reported that insulin increases cholesterol synthesis and secretion of very low density lipoprotein (Reaven, 1978).

Triglycerides

The mean triglyceride value of the control on the 30thday is (175 ±1.22, p<0.05). There is a substantial decrease in all the experimental groups treated with fenugreek (150±0.70, p<0.05), (145±1.00, p<0.05), (130±1.41,

p<0.05). The one way ANOVA is significant at 1% level. The mean triglyceride value of the control on 45th day is (175±1.2247, p<0.005). There is a substantial decrease in all the experimental groups (160±1.0000, p<0.005), (155±0.7071, p<0.005), (140±1.0000, p<0.005). The one way ANOVA is significant at 1% level.

Total Cholestrol

The total cholesterol values showed a significant decrease in all the treatments 1g, 3g, and 5g fenugreek treated fishes 1g (154±1.41, p<0.05), 3g (148±1.00, p<0.05), 5g (140±0.70, p<0.05) when compared to the control (160 ± 1.14, p<0.05). The one way ANOVA is significant at 1% level. The total cholesterol values showed a significant decrease in all the treatments 1g, 3g,and 5g fenugreek treated fishes 1g (162±0.70, p<0.05), 3g (158±1.48, p<0.05), 5g (150±1.14, p<0.05)when compared to the control on 45th day (170±1.30, p<0.05). The one way ANOVA is significant at 1% level.

LDL

The LDL value of the control on 30th day is (86 ± 1.22, P<0.05).There is a considerable decrease in all the experimental groups treated with fenugreek on 30th day (75±0.70, P<0.05), (68±1.00, P<0.05), (56±0.70, P<0.05).The one way ANOVA for the levels of LDL in the control and experimental is significant at 1% level. The total LDL value of the control on 45th day is (90±1.65, P<0.05).There is a considerable decrease in all the experimental groups (80±0.50, p<0.05), (72±1.35, P<0.05), (62±1.75, P<0.05). The one way ANOVA for the levels of LDL in the control and experimental is significant at 1% level.

HDL

The control value for High Density Lipid is 39.00. Significant increase in High Density Lipid is observed in1g (49±1.57, P<0.05), 3g (51±1.73, P<0.05), 5g (58±1.26, P<0.05) of fenugreek treated fishes. The one way ANOVA is significant at 1% level. The control

value for High Density Lipid on the 45th day is 45.00. Significant increase in High Density Lipid is observed in 1g (50 ± 0.62, $p<0.05$), 3g (56 ± 1.07, $P<0.05$), 5g (62 ± 0.70, $P<0.05$) of fenugreek treated fishes. The one way ANOVA is significant at 1% level.

The lipid lowering effect of fenugreek is due to its action on the adipocytes and the liver cells, which leads to decreased triglycerides and cholesterol synthesis in addition to an enhanced low density lipoprotein (LDL) receptor mediated LDL uptake (Jetle *et al*., 2009).

Intake of fenugreek seeds resulted in significant reduction in LDL. Meals containing fenugreek seeds inhibit both cholesterol absorption in the intestines and cholesterol production by the liver (Neelakantan *et al*., 2014). Fenugreek seeds also contain a gel-like soluble fiber that has been exhibited to combine with bile acids and lowers the triglyceride (TG) and LDL levels (Valette *et al.,* 1984).

Intake of fenugreek seeds resulted in significant increase in HDL. Fenugreek seeds also contain lot of fibers that bind with cholesterol, preventing its absorption. The regular use of fenugreek seeds prevents the deposition of cholesterol and increases the HDL. (Neelakantan *et al*., 2014).

The galactomannan (polysaccharide cell wall component) isolated from fenugreek exihibited a prominent selective inhibitory effect against intestinal lipase activity. It was found to significantly increase the HDL level (Khaled *et al*., 2010).

Multiple human trials on fenugreek seeds also demonstrated the potential efficacy in lowering total cholesterol in people with moderate atherosclerosis or insulin- or non-insulin-dependent diabetes. A human double-blind trial has demonstrated that defatted fenugreek seeds may raise the HDL (Prasanna *et al.,* 2000). HDL cholesterol increased significantly in group who received 1 gm/day fenugreek seeds as compared to diabetic group patients (Hamza *et al.,* 2012).

Fenugreek seed powder lowers the levels of cholesterol and triglycerides. Seeds of fenugreek is a rich source of fiber. Fenugreek seeds have also been reported to lower total and LDL cholesterol and triglycerides levels in people with high levels. Randomized trial demonstrated that fenugreek seed extract (100 g/day) lowers elevated Triglycerides and other lipid levels (Prasanna *et al*., 2000)

Enzymes
Alanine amino transferase
The values of Alanine amino transferase showed a significant decrease in all the treatments 1g, 3g,and 5g fenugreek treated fishes 1g (13 ± 0.70,$p<0.05$), 3g (12 ± 0.70, $p<0.05$),5g (12 ± 0.70, $p<0.05$) on the 45th day. The one way ANOVA is significant at 1% level

Aspartate amino transferase
The values of Aspartate amino transferase showed a significant decrease in all the treatments 1g, 3g,and 5g fenugreek treated fishes 1g (31 ± 0.70, $p<0.05$), 3g (23 ± 0.70,$p<0.05$), 5g (21 ± 0.70, $p<0.05$) when compared to the control on 45th day (35 ± 0.70, $p<0.05$). The one way ANOVA is significant at 1% level.

AST is an enzyme that is found mostly in the liver, but also in muscles. When the liver is damaged, it releases AST into the blood stream. ALT is also found inside the liver cells. ALT is typically used to detect liver injury. The plasma levels of ALT and AST in liver cellular degradation will increase (Newairy *et al*., 2009)

Fenugreek displays significant decrease in Serum AST and ALT. Liver shows amelioration in histological pattern (Bin-Hafeez *et al*., 2003). In addition, fenugreek galactomannan efficiently protects the hepatic function observed by the considerable decrease of aspartate and alanine amino transaminase (Khaled *et al*., 2010).

The results demonstrated that the supplementation of fenugreek seed powder in the diet leads to a reduction in biomarkers of oxidative damage in alloxan induced diabetic disease (Ravikumar *et al*., 1999).

The extract of fenugreek cause significant decrease of AST, ALT. These indicate that the extract may reduce hepatic damage. In medicine, the presence of elevated values of ALT and AST is indicative of liver damage (Giboney, 2005).

CONCLUSION

In our study, it has been observed that fenugreek seeds have a significant lower glycaemic response in fishes. It can be used to decrease the blood glucose levels in diabetic patients and has the ability to reduce Serum Cholesterol, Triglyceride, LDL and able to raise HDL. Fenugreek given 15 minutes before the meal causes a significant reduction in Glycemic index and is beneficial to Non insulin-dependent diabetes mellitus patients for long term control of their blood glucose levels and prevention of hyperglycaemic related complications (Sampath *et al*., 2011).

REFERENCES

1. Vidya M K, Karna K B, Payghan S. and Shailesh P .A current status of diabetes mellitus in india: a review.*Wld j. phcy phatical scie*., 2017; 6(8): 235-243.
2. Mehta S R, kashyap A S and das S. Diabetes mellitus in india: the modern scourge. *Meal J*., 2009; 65(1): 50–54.
3. Fatima T, Maqbool K and Hussain S Z. Potential health benefits of fenugreek. *J .Med Plts Stu*., 2018; 6(2): 166-169.

4. Mullaicharam A R, Geetali D and Uma M R. Medicinal Values of Fenugreek – A Review. *Resch J. Phcal, Bcal Chal Sci*., 2013; 4(1): 1304-1313.

5. Yanardag R, Bolkent S, Karabulut B O and Tunali S. Effects of vanadyl sulfate on kidney in experimental diabetes. *Biol Trace Elem Res.*, 2003; 95(8): 73–85.

6. Subhash B L, Kulkarni C P, Arvindkumar G E, Mohan V and Prasad T A Antidiabetic activity of *trigonella foenumgraecum*l. seeds extract in neonatal streptozotocin-induced rats. *Digal Ctica j*., 2012; 5(2): 41-1.

7. Nandini S and Suvarna K .Effect of indigenous foods (fenugreek, black sesame and bittercumin) on blood glucose level of type – 2 diabetic patients .*Inter J. scient res biol sci.,* 2015; 2(5): 17-20.

8. Arunima D, Kamakhya K, Shiv K and Bandyopadhyay A. Effect of fenugreek seeds on glycemia and dyslipidemia in patients with type 2 diabetes mellitus. *Inter J. Medi Sci Pub Hlth.,* 2015; 4(7): 997-1000.

9. Majid A M A and Dahham S S. The impact of life style and nutritional components in primary prevention of colorectal cancer *J. Appl Phar Scie.,* 2016; 6(9): 237-244.

10. Arumugam P, Pushpam M, Durairajan P, Joshua P P. Fenugreek [Trigonella foenum-graecum] linn- a reducer of glucose and lipid profile in diabetic subjects.*Wld j. phtical scie*., 2017; 5(6): 271-277.

11. Bhosale S V, Bhilave M P and Nadaf S B.Formulation of fish feed using ingredients from plant sources. *Rech J. Agral Sci*., 2010; 1(3): 284-287.

12. Trinder P. Glucose-GOD/ PAPkit. Ann. Clin. *Biochem.,* 1969; 6(7): 24-29.

13. Richmond W. preparation and properties of cholesterol oxidase from nocardiasp and its application to enzymatic assay of total cholesterol serum.*Clin. Chem.,* 1973; 33(2): 1350-1356.

14. Sidel J, Hagele E, Ziegenhorn J, and Wahlefeld A W. Reagent for the enzymatic determination of serum total cholesterol with improved lipolytic efficiency. *Clin. Chem.,* 1983; 20(5): 1075-1080.

15. Fossati P, and Prencipe L. Measurement of serum triglycerides determined colorimeterically with an enzyme that produces hydrogen peroxide. *Clin. Chem.,* 1982; 28(10): 2077-2080.

16. Friedewald, W I, *et al., Clin.Chem.* 1972; 18: 499-502.

17. Uddin M J *et al.,* Detection of quantitative trait loci affecting serum cholesterol, LDL, HDL, and triglyceride in pigs. *BMC Geics,* 2011; 12(6): 62.

18. Reitaman S and Frankel S. A colorimetric method for the determination of serum glutamic oxaloacetic and glutamic pyruvic transaminases', *Amrn J.Clcal Plogy.*, 1957; 28(8): 56.

19. Staub H.The Glycaemic Index: A Physiological Classification of Dietary Carbohydrate. *Zeft fur klche mein.,* 1921; 91(1): 44-60.

20. Raghuram T C.fenugreek the wonder seed in disease management. *nutr.dis.management*, 2005; 26(4): 7-14.

21. Reaven Formulation of fish feed using ingredients from plant sources. *Rech J Agri Sci*., 1978; 45(6): 43-49.

22. Jetle N, Shah S and Prasanna K K M. Current Status of Diabetes in India and Need for Novel Therapeutic Agents. *J. assoc phns india., 2009; 67(2): 31-37.*

23. Neelakantan A, Shankar J and Passos A.Fenugreek: productivity, nutritional value and uses.*Inter j. medi scie., 2014; 23(1): 17-25.*

24. Valette, G, Sauvaire Y., Baccou, J.C., & ribes, G .Atherosclerosis. *Inter J. Bic App Phygy,* 1984; 50(6): 105-110.

25. Neelakantan A, Shankar J and Passos A.Fenugreek: productivity, nutritional value and uses.*Inter j. medi scie., 2014; 23(1): 17-25.*

26. Khaled H, jaovadi B, solami T, carreau S. Modulatory effect of fenugreek saponins on the activities of intestinal and hepatic disaccharidase and glycogen and liver function of diabetic rats. *Inter j. med sci., 2010;* 15(5): 745-753.

27. Prasanna M. Hypolipidemic effect of fenugreek: a clinical study.*Indian Journal of Pharmacology*., 2000; 32(5): 34-36.

28. Hamza C A, Shannon L, Teena W. Hypolipidemic effect of fenugreek and garlic on experimentally induced hyperlipidemia in rabbits: a randomized control trial. *J.Cli Psy., 2012; 32(6): 482-495.*

29. Newairy AS, Salama AF, Hussien H M and Yousef MI, Propolis alleviates aluminium-induced lipid peroxidation and biochemical parameters in male rats. *Food Chem Toxicol.*, 2009; 47(6): 1093-1098.

30. Bin-Hafeez, B, Haque R, Parvez S, Pandy, Sayeed S I and Raisuddin S. Immunomodulatory effects of fenugreek extract in mice .*Int. Imrcol*., 2003; 6(2): 257-262.

31. Khaled H, jaovadi B, solami T, carreau S. Modulatory effect of fenugreek saponins on the activities of intestinal and hepatic disaccharidase and glycogen and liver function of diabetic rats. *Inter j. med sci., 2010;* 15(5): 745-753.

32. Ravikumar P and Anuradha C V. Effect of fenugreek seeds on blood lipid peroxidation and antioxidants in diabetic rats. *Phytother. Res*., 1999; 13(7): 197–201.

33. Giboney. Atropine toxicity and liver enzymes in rattus norvegicus. *Inter J. El che, 2005; 34(6): 78-80.*

34. Sampath K V, Rama R J, Ambika D K, Shruti M. comparative study of fenugreek seeds on glycemic index in high and medium dietary fiber containing diets in NIDDM patients.*nat j.ind rec med, 2011; 2(3):* 2230 – 9969.