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## ORIGINAL STUDY

# Effect of Fenugreek Seeds and Curry Leaves Powder on Dyslipidemia- A Randomized Controlled Pilot Study

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### Abstract

**Background:** Dyslipidemias, a disorder of lipid metabolism, is widely established as an independent major and modifiable risk factor of cardiovascular disease (CVD). The conditions are common worldwide and a leading cause of death in India, and has even riven the age bar swaying in young people too. The significant effect of an increase in dyslipidemias depends on diabetes and hypertension. Nutraceuticals, derived from food sources serve as an alternative therapy for the management of dyslipidemia. India is home to multitudinous medicinal plants, of which many remain underutilized. *Murraya Koenigii* (curry leaf) and *Trigonella foenum-graecum* (fenugreek leaves) are well-proven as good sources of nutraceutical and functional foods.

**Objectives:** To study the effect of fenugreek and curry leaves powder on dyslipidemia and also the dietary habits of dyslipidemic subjects.

**Materials and methods:** 31 subjects aged between 40 and 70 years were recruited based on inclusion and exclusion criteria, and grouped into group 1(hypertensive with dyslipidemia), group 2 (diabetic with dyslipidemia), and group 3 (only dyslipidemia) supplemented with the mixture of fenugreek and curry leaf powder for 3 months.

**Results:** Reduction in total cholesterol and triglyceride levels were observed in group 2 (DM + DLP) and group 1 (HTN + DLP) i.e  $221.2 \pm 29$  and  $193 \pm 72.4$  respectively. The HDL levels increased in all three groups. Reduced VLDL and FBS levels were observed in all three groups.

**Conclusion:** Our findings showed that fenugreek and curry leaf powder supplementation, as a phenolic-rich herb can be effective in the reduction of some lipid profiles in dyslipidemic patients suggesting their potential nutraceutical role in treating CVD.

**Keywords:** Nutraceuticals, Lipid profile, Cardio-vascular disease

## 1. Introduction

Dyslipidemia and hypertension are important risk factors for cardiovascular diseases (CVD) [1]. Dyslipidemia, a disorder of lipid metabolism is defined as the abnormal levels of lipid parameters such as total cholesterol (TC), low-density lipoprotein (LDL), very low-density lipoprotein (VLDL), triglycerides (TAG), and high-density lipoprotein (HDL), it is the most concerned leading cause of increased morbidity and mortality which is the current medical and social problem [2,3]. It is

observed that hypertension and dyslipidemia coexisted in daily clinical practice, a possible relationship may be due to common pathophysiological etiologies like obesity resulting in dysregulation and adipocytokine release from adipose tissue [4,5]. Epidemiological studies have reported the prevalence of hypertension and its association with an increase in blood lipid levels [6,7]. Studies have shown that dyslipidemia is more common among men aged between 30 and 40 years with an increased prevalence of young infants due to coronary artery disease [8,9]. Current guidelines of the

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American Association of Clinical Endocrinology (AACE) have suggested that prevention and management of dyslipidemia are essential in the development of coronary artery disease (CAD) [10]. Several approaches have been made in recent times for combating this life-threatening metabolic disorder. It has been reported that regardless of the use of many lipid-lowering drugs such as statins, a significant number of subjects did not reach their target levels of LDL and experienced side effects because of these drugs [11]. Therefore, due to this reason, other approaches for treating combined hyperlipidemia may be considered. Alternatively, in recent years the importance of medicinal plants and their bioactive compounds have been used for the management of dyslipidemia. Fenugreek (*Trigonella foenum-graecum*) belonging to the Fabaceae family, is rich in antioxidants and phenolic compounds containing flavonoids, such as kaempferol 3-O-glycoside, apigenin-7-O-rutinoside, and naringenin and Curry leaf (*Murraya koenigii*) Spreng, belongs to Rutaceae family, is one of the most commonly used flavoring agents in India [12,13]. Various pharmacological activities of phytochemical constituents from *M. koenigii* have been reported to have a potential role as an important nutraceutical for diabetes and cardioprotection. Curry leaves are reported to have a wide range of phytochemicals viz., carbazole alkaloids, essential oil, carotenoids-lutein, phenolics, terpenoids,  $\alpha$ -tocopherol, minerals, fibers, nicotinic acid, vitamin C [14].

In-vitro studies have been reported where leaves of *M. Koenigii* significantly decreased both total cholesterol and triglycerides in high-fat diet-fed rats [15]. On the other hand, fenugreek seeds have been found to exhibit hypolipidemic and anti-diabetic effects. Lipid-lowering effects of fenugreek were found to have kaempferol, apigenin, and naringenin, the flavonoid compound found abundantly to have significant hypocholesterolemic effects [16]. However, there is a dearth of data on the efficacy of medicinal plants on lipid profiles in clinical trials. Hence the current study aimed in determining the effect of curry leaf and fenugreek powder on dyslipidemic individuals.

## 2. Methodology

### 2.1. Preparation of curry leaves and coriander seed powder

Fresh curry leaves were collected from own field (organic) and Fenugreek seeds were obtained from the market washed thoroughly using water and dried under a sunshade and roasted without adding

oil. The roasted dried leaves and fenugreek seeds were powered under clean conditions using a kitchen grinder and stored in a food-grade plastic container as small samples.

### 2.2. Participants

The study protocol is as shown in Fig. 1. A total of 31 subjects with dyslipidemia were recruited based on convenient sampling, and grouped into three, group 1 (hypertension and dyslipidemia, HTN + DLP), group 2 (diabetes mellitus and dyslipidemia, DM + DLP), and group 3 (only dyslipidemia, DLP), with the inclusion criteria being both men and women aged between 40 and 70 years. The subjects having obesity, hypertension, diabetes, and dyslipidemia but suffering from thyroid disorders, underwent surgical intervention in gastrointestinal and autoimmune diseases, irritable bowel syndrome, renal and liver impairment, and those not willing to participate were excluded. The present study was conducted in Delhi, India, and was piloted from January to June 2022.

After the initial screening, fasting (overnight fasting of 8–10 h) blood samples were collected for the determination of lipid profile. Thirty one subjects with mild dyslipidemia (elevation of TC of average of 200–230 mg/dl with LDL-C >130 mg/dl or HDL-C.

### 2.3. Trial design

The subjects were allocated into four groups and had been instructed to consume 5 g of the mixture (curry leaves and fenugreek powder, 1:1) adding in the lukewarm water on an empty stomach, lemon was added optionally to increase the palatability. The test substances were consumed once daily for 90 consecutive days. The subjects were given nutritional counseling after which the modification in the diet was made and instructed to maintain a regular lifestyle and increase physical activity. The use of alcohol and other lipid metabolism affecting drugs was prohibited. Nutritional assessment protocol included POMR (Problem Oriented Medical Records) and SOAP (Subjective, Objective data, Assessment, and Plan). The subjective data, elicited information regarding an individual's appetite, hunger, bowel, sleep pattern, and, social habits, and objective data included anthropometry, biochemical, clinical, and dietary recall. The anthropometric measurements like weight, and height, were measured waist-hip ratio, mid-upper arm circumference, demonstrated fat percent, and BMI was calculated. Demographic variables like age,

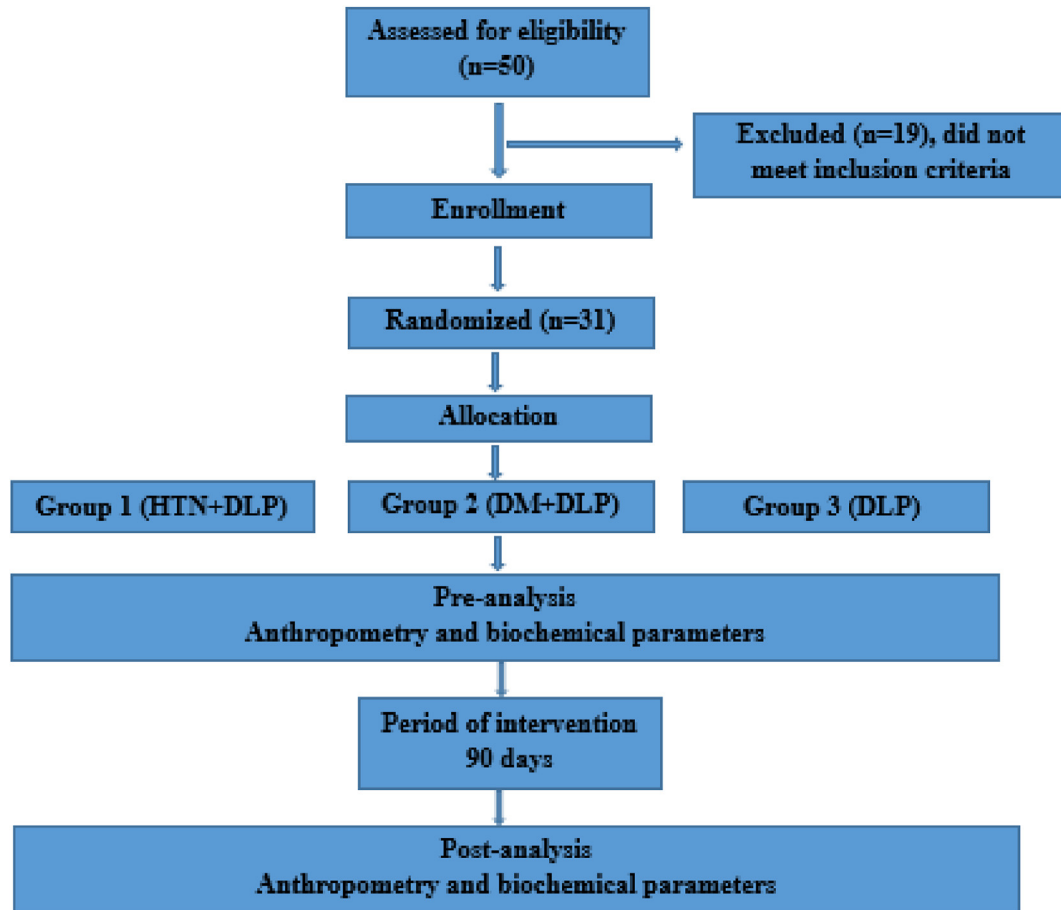


Fig. 1. Flow chart of the study participants.

education, occupation, or duration of dyslipidemia were collected using a structured questionnaire. A daily telephone call was performed to remind them and visited the subjects at the end of each week to comply with consumption as well as to enquire about any adverse effects of consumption. Fasting blood samples were collected after the intervention and determined the lipid profile. Fasting blood glucose, and lipid profile (TC, HDL, LDL, VLDL, and TAG) in pre- and post-intervention serum samples were analyzed using a fully automated clinical chemistry analyzer in a diagnostic lab that had an acceptable quality assurance program.

#### 2.4. Statistical analyses

Statistical analysis was performed using the statistic software package (SPSS, 16.0, International Business Machines, USA). The Shapiro–Wilk test was used to test data distribution normality. The results of quantitative data were reported as mean  $\pm$  SD. Paired *t*-test was used to determine the significant difference between the mean values of lipid profile parameters in

the pre- and post-interventional samples. Significance between the groups and within the groups for pre and post was studied by using ANOVA.  $P < 0.05$  was considered significant.

#### 2.5. Ethical clearance

Written informed consent was obtained from all participants. Besides, the study protocol was approved by Institutional Ethics Committee (JSSMC-IEC/050722/41NCT/2022–23).

### 3. Results

#### 3.1. General characteristics

Among the study subjects, 19 of them (out of 50) were excluded since they did not meet the study inclusion criteria and were not willing to participate. Finally, 31 subjects completed this study, 10 men (32.3%), 13 women (41.8%) were between 40 and 50 years of age, 5 men (16.1%) were between 51 and 60 years of age, and 1 man (3.2%), 2 women (6.4%) were aged between 61 and 70 years of age (Table 1).

Table 1. General characteristics of study population.

Age (years)	Men, n (%)	Women, n (%)	Total Percent (%)
40–50	10 (32.3)	13 (41.8)	74.1
51–60	5 (16.1)	0	16.1
61–70	1 (3.2)	2 (6.4)	9.6

The BMI of the dyslipidemic subjects is as shown in Fig. 2. It was observed that 6.5% of men subjects of the study population were under the normal range. Around 23% and 10% of men and women were categorized as overweight, 16.1% and 34.5% of men and women as grade 1 obesity, and 6.5% and 3.2% of men and women as grade 2 obesity respectively.

Constipation (27%) was observed more among the dyslipidemic subjects, the other health related problems observed were abdominal distension (18%), flatulence (18%), diabetes (21%) and hypertension (16%) (Fig. 3).

The fat percentage among men is shown in Fig. 4. As per standards, the skin fold thickness was taken from four different locations (biceps, triceps, subscapular, and superailiac region). The majority of men subjects were obese in both 40–59 and  $\geq 60$  years' age group. The fat percentage among women is shown in Table 2. A similar trend was observed in the case of women subjects where, the majority of them were obese belonging to both 40–59 and  $\geq 60$  years age groups.

The anthropometric parameters like waist-hip ratio and mid-upper arm circumference (Fig. 5)

were measured, the majority of the study population had high abdominal obesity ( $>0.9$  and  $>0.85$  in men and women respectively) and mid-upper arm circumference ( $>29.3$  cm and  $>28.5$  cm in both men and women respectively).

The mean value for both pre and post-lipid profiles is shown in Table 2. The results of this intervention showed a significant difference in TAG, HDL, VLDL, and FBS ( $P < 0.01$ ). No significant difference was observed for other parameters (TC and LDL). There were significant reductions in TAG, VLDL, and FBS and an increase in HDL levels in all groups treated with the fenugreek and curry leaf powder after 12 weeks when compared with baseline. Improvement in HDL between the groups was observed but was not statistically significant. Reduction in lipid values from pre to post was observed in all the groups (Table 3).

The comparison of pre and post intervention biochemical parameters among dyslipidemia subjects is shown in Tables 4–9. Significant difference between the groups was observed in triglyceride and very low density lipoprotein levels among both pre and post intervention subjects having dyslipidemia with hypertension and diabetes mellitus. Also, a significant difference was observed between the groups for fasting blood glucose levels among pre and post intervention subjects having dyslipidemia, and dyslipidemia with hypertension and diabetes mellitus.

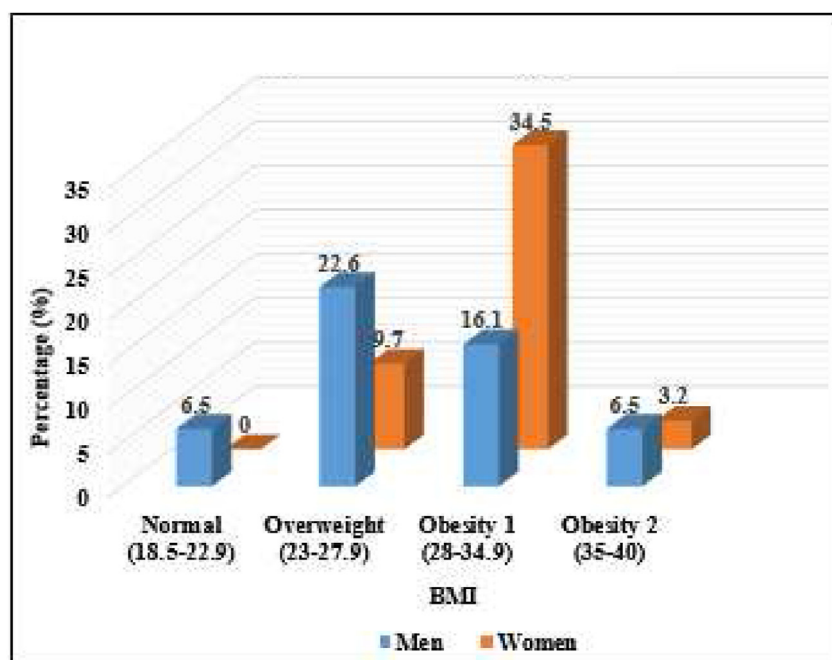


Fig. 2. BMI of the study population.

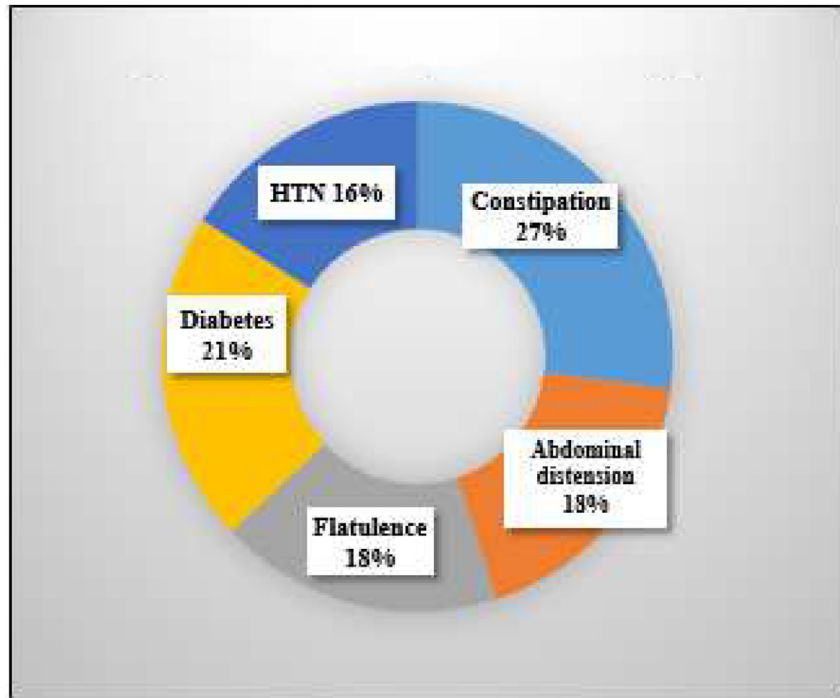


Fig. 3. Associated health problems of the study population.

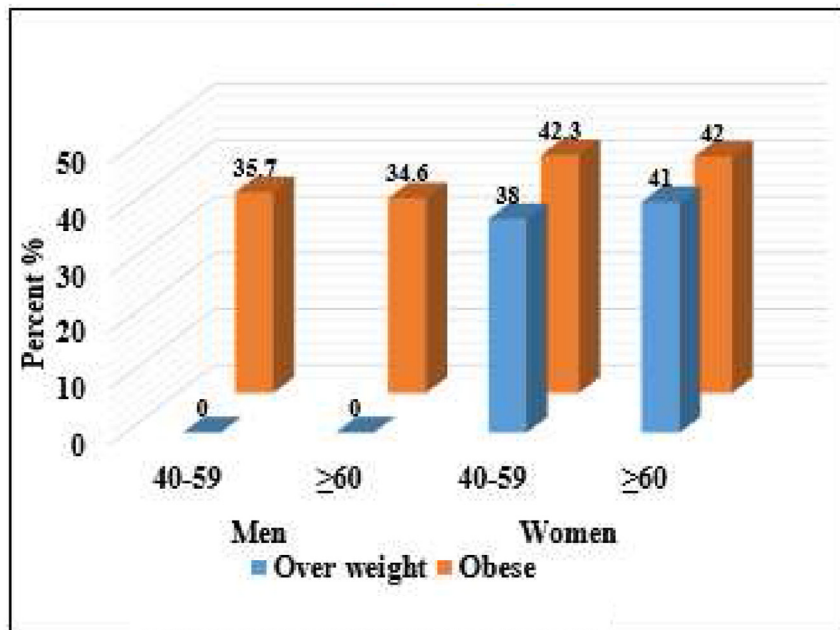


Fig. 4. Fat Percent dyslipidemic subjects.

#### 4. Discussion

In many dyslipidemic patients, it is difficult to maintain the lipid profiles in an optimal range and therefore high doses of drugs from different pharmacological classes of anti-dyslipidemia are needed in maintaining the levels in the normal range.

Medical side effects can be aroused when there is an increase in the number and dosage of drugs causing a decrease in a patient's compliance. Conversely, cessation of treatment is not possible. Hence, it seems to be more sensible to introduce some adjunct therapies, such as herbal therapies which have no side effects in the long run.

Table 2. Comparison of the effect of fenugreek seed and curry leaves powder on the post intervention lipid profile values.

	Pre	Post	t	P
TC	221.97 ± 18.32	222.02 ± 17.32	-0.037	0.971
TAG	176.73 ± 31.61	167.46 ± 17.16	2.954	0.006 <sup>a</sup>
HDL	40.74 ± 7.11	44.33 ± 6.74	-12.660	0.000 <sup>a</sup>
LDL	150.18 ± 8.79	150.26 ± 8.56	-0.074	0.942
VLDL	37.92 ± 8.95	32.79 ± 7.11	7.024	0.000 <sup>a</sup>
FBS	107.28 ± 16.73	98.60 ± 12.27	7.498	0.000 <sup>a</sup>

<sup>a</sup> Statistically significant P < 0.05.

It was observed that constipation was the major health problem observed in the dyslipidemic subjects followed by diabetes, abdominal distension, flatulence, and hypertension.

Table 4. Comparison of pre and post intervention of total cholesterol levels between and within the groups.

Total Cholesterol		Group 1	Group 2	Group 3
Group 1	Pre	—	0.195	0.082
	Post	—	0.975	0.801
Group 2	Pre	0.195	—	0.950
	Post	0.970	—	0.912
Group 3	Pre	0.082	0.950	—
	Post	0.801	0.912	—

In the current study, there was a significant reduction in the lipid parameters in dyslipidemic subjects. There was a decrease in TC, LDL, and VLDL in all the groups, but TAG was reduced only in groups 1 and 3. This decrease indicated that

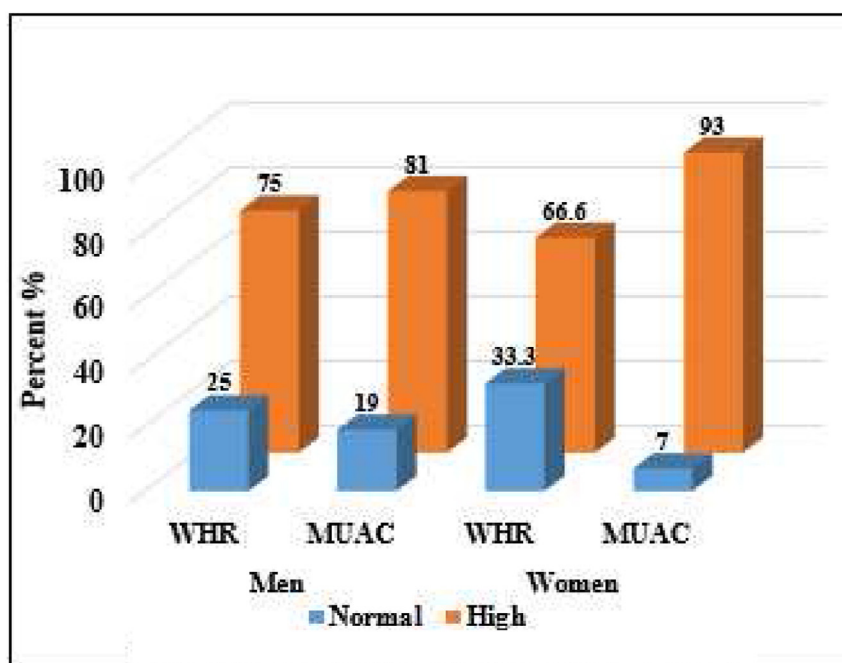


Fig. 5. Anthropometric data of dyslipidemic subjects.

Table 3. Comparison of pre and post intervention of biochemical parameters between the groups.

	Group 1 (mean ± SD)	Group 2 (mean ± SD)	Group 3 (mean ± SD)	P
TC Pre	208.81 ± 5.25	224.41 ± 19.63	226.65 ± 18.59	0.089
TC Post	218.90 ± 9.54	221.01 ± 19.51	224.08 ± 18.71	0.801
TAG Pre	227.83 ± 17.89	150.37 ± 8.49	168.71 ± 11.70	0.000 <sup>a</sup>
TAG Post	193.08 ± 5.31	156.47 ± 7.61	162.09 ± 12.02	0.000 <sup>a</sup>
HDL Pre	38.35 ± 7.62	40.47 ± 7.45	42.01 ± 6.57	0.543
HDL Post	43.82 ± 6.73	43.40 ± 7.17	45.14 ± 6.59	0.818
LDL Pre	153.95 ± 8.97	152.55 ± 9.38	147.0 ± 7.28	0.142
LDL Post	148.63 ± 8.64	151.12 ± 10.43	150.5 ± 7.29	0.846
VLDL Pre	49.84 ± 4.81	32.71 ± 5.54	35.49 ± 6.87	0.000 <sup>a</sup>
VLDL Post	39.26 ± 4.69	29.03 ± 5.55	32.03 ± 6.96	0.010 <sup>a</sup>
FBS Pre	106.63 ± 6.18	129.21 ± 7.97	94.44 ± 7.52	0.000 <sup>a</sup>
FBS Post	100.81 ± 4.07	112.78 ± 7.79	89.06 ± 6.87	0.000 <sup>a</sup>

<sup>a</sup> Statistically significant P < 0.05, Group1- HTN + DLP, Group 2- DM + DLP, Group 3- DLP.

Table 5. Comparison of pre and post intervention of triglycerides levels between and within the groups.

Triglycerides		Group 1	Group 2	Group 3
Group 1	Pre	–	0.000**	0.000**
	Post	–	0.000**	0.000**
Group 2	Pre	0.000**	–	0.005**
	Post	0.000**	–	0.378
Group 3	Pre	0.000**	0.005**	–
	Post	0.000**	0.378	–

Table 6. Comparison of pre and post intervention High density lipoprotein cholesterol levels between and within the groups.

HDL		Group 1	Group 2	Group 3
Group 1	Pre	–	0.831	0.517
	Post	–	0.992	0.909
Group 2	Pre	0.831	–	0.868
	Post	0.992	–	0.824
Group 3	Pre	0.517	0.868	–
	Post	0.909	0.824	–

Table 7. Comparison of pre and post intervention Low density lipoprotein cholesterol levels between and within the groups.

LDL		Group 1	Group 2	Group 3
Group 1	Pre	–	0.943	0.192
	Post	–	0.842	0.884
Group 2	Pre	0.943	–	0.284
	Post	0.842	–	0.985
Group 3	Pre	0.192	0.284	–
	Post	0.889	0.985	–

Table 8. Comparison of pre and post intervention Very Low density lipoprotein cholesterol levels between and within the groups.

VLDL		Group 1	Group 2	Group 3
Group 1	Pre	–	0.000**	0.000**
	Post	–	0.008**	0.044*
Group 2	Pre	0.000**	–	0.544
	Post	0.008**	–	0.497
Group 3	Pre	0.000**	0.544	–
	Post	0.044*	0.497	–

\*\*P < 0.01, \*P < 0.05, Group1- HTN + DLP, Group 2- DM + DLP, Group 3- DLP.

Table 9. Comparison of pre and post intervention fasting blood glucose levels between and within the groups.

FBS		Group 1	Group 2	Group 3
Group 1	Pre	–	0.000**	0.004**
	Post	–	0.005**	0.002**
Group 2	Pre	0.000**	–	0.000**
	Post	0.005**	–	0.000**
Group 3	Pre	0.004**	0.000**	–
	Post	0.002**	0.000**	–

\*\*P < 0.01, \*P < 0.05, Group1- HTN + DLP, Group 2- DM + DLP, Group 3- DLP.

supplementation of fenugreek and curry leaf powder in combination enhanced the process of achieving eulipidemia. An alternative significant

increase in HDL level, good cholesterol was observed among the subjects. Which is considered to show a protective effect against heart diseases, signifying the intense conversion of LDL to HDL and circulating lipids clearance. This property of lipid regulation would be beneficial in preventing plaque formation in atherosclerosis and coronary artery disease. This study reveals the beneficial effect of fenugreek and curry leaves powder in atherosclerosis. Study on the hypolipidemic effects of fenugreek has also been observed in other experimental animals like rabbits [17].

A study by Ballagalle (1997), showed a decline in total cholesterol when supplemented with curry leaf powder twice a day [18]. Another study by Molly et al. (2017), on post-menopausal women with dyslipidemia who were on with and without hypolipidemic drugs, showed a reduction in TC, TAG, LDL and an increase in HDL levels [19]. Phytochemical constituents like carbazole alkaloids were reported as anti-cholinesterase and hypocholesterolemic mechanisms in the anti-amnesic effect of ethanolic extract of *M. koenigii* leaves [20].

It was observed that the HDL levels were low in hypertension with dyslipidemia subjects. Our observation is in agreement with the studies done by other researchers [21-23]. Many pathophysiological mechanisms are involved in the association between dyslipidemia and an increased risk of hypertension [1].

Significant reduction in total cholesterol, triglycerides and very low-density lipoproteins was observed in rats after treatment with fenugreek seeds soaked in hot water for eight weeks. The chemical saponins and pectin present in fenugreek powder may increase the biliary cholesterol excretion, decrease the lipid levels in the body and lower the triglyceride levels by absorbing the bile acids respectively [24,25]. Also, Fenugreek acts on adipocytes and liver cells decreasing the synthesis of triglycerides and cholesterol as well as enhancing LDL receptor mediated lipid intake [26].

From the study, it was found that fenugreek and curry leaf powder when administered as a dietary supplement in the dyslipidemic subjects showed a statistically significant reduction in the serum LDL, TC, TAG, and VLDL and a significant increase in the HDL cholesterol values. A study done by Belguith HO et al., showed that the antioxidant effect of fenugreek had no toxic or adverse effects on consumption [27]. Therefore, fenugreek and curry leaf can be used in dyslipidemic individuals as lipid-lowering agents. On the whole, our results may add to the accumulation of evidence of using medicinal plants in lowering the lipid profile among dyslipidemic Asian populations.



#### 4.1. Limitation

This study has many potential limitations. First, due to limited time, the sample size and the subject selection were done based on convenient sampling. Second, the antioxidant property and polyphenol contents of fenugreek and curry leaf powder in combination were not performed to know the activity. Third, since fenugreek and curry leaves are consumed commonly in our daily cooking, toxicity studies were not done. Fourth, since this was an observational study, the possibility of a reverse association between dyslipidemia and hypertension, diabetes, and hypertension could not be ruled out.

*Future line of work:* Further large-scale multicentric studies are warranted based on the current study; by using fenugreek and curry leaf powder as a supplement for uncontrolled dyslipidemic patients.

#### 5. Conclusion

From the above results it is proved that the combination of fenugreek and curry leaf powder is a potent hypolipidemic agent with a significant increase in HDL cholesterol and reduction in other lipid parameters. Therefore, dietary supplementation of fenugreek and curry leaf powder along with lifestyle modification can be effective in combating the increasing risks of dyslipidemias among individuals. Hence, the simplest and safest way for effective management of dyslipidemia remains the combination of dietary modification along with certain therapeutic interventions.

#### Financial support and sponsorship

Nil.

#### Conflict of interest

There are no conflicts of interest.

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