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Effects of 6 Weeks of Aerobic Training and Fenugreek Extract Administration on Plasma Apo A-I of Female Patients with Type 2 Diabetes

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Abstract

Purpose: Fenugreek, as an herbal plant, can significantly increase Apo A-I, an important factor in preventing cardio vascular diseases among diabetic patients, which is a major cause of their mortality. Considering that exercise activities have a positive effect on diabetic patients, this study aimed to investigate the effects of 6 weeks of aerobic training and fenugreek administration on Apo A-I levels of diabetic women.

Material and Methods: Thirty diabetic women volunteered to take part in the present study and were randomly placed into three groups: aerobic training (Group 1), aerobic training+ fenugreek administration (Group 2) and control group (Group 3). Aerobic training group exercised for 6 weeks, at 60-75 %of their maximal heart rate. Blood sampling was done before and after the trial.

Results: There was a significant decrease in weight, body fat percent, BMI and fasting blood sugar, and a significant increase in Apo A-I, HDL and HDL/LDL ratio ($p<0.001$) in the groups 1,2. A significant decrease was also observed in TG levels of group 1. Increased level of LDL was the only significant change observed in the control group. Total cholesterol and HDL/LDL ratio of group 2 decreased and increased, respectively, as compared to group 1 ($p<0.05$).

Discussion and Conclusion: Fenugreek extract along with aerobic training can be useful in increasing levels of Apo A-I and lowering LDL levels in diabetic patients.

Keywords: Aerobic training, T2DM, Apo A-I

Introduction

Sedentary lifestyle is one of the factors influencing the increased level of the blood lipids [1]. On the other hand, prevalence of fatness and sedentary lifestyle are the major causes of T2DM which has become a general global health problem. Epidemic increase in T2DM results from extensive changes in populations and their different behaviors. Although genetic composition is a major factor for susceptibility against diabetes, social changes and increased level of energy intake in the world's diet are effective drives for diabetes to become epidemic.[2]

T2DM is often associated with abnormalities in lipid metabolism and a higher level of plasma fatty acids plays a crucial role in increased level of insulin resistance. Furthermore, the plasma fatty acids cause dyslipidemia through increasing synthesis of VLDL and cholesterol transferring protein in liver as well as increasing LDL and decreasing HDL. This atherogenic function of lipoproteins (increase in triglyceride, lipoprotein LDL and decrease in HDL) leads to atherosclerosis and a rise in the risk of cardiovascular diseases, which are the most prevalent causes of mortality among T2DM patients.[3]

Today, traditional treatment of diabetes using of some plants or plant extracts has attracted attention of many people across the world.

Fenugreek (*Trigonella foenum-graceum* **L.**) is an annual grassy plant endemic to east Mediterranean. It has many healing effects such as being anti-atherosclerotic, anti-inflammatory, antiseptic, anti-tumor and soothing, laxative, expectorant, diuretic, and anti-parasitic and is effective in decreasing plasma cholesterol, lowering hypertension. [5, 6, 7,

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Trigonilin nicotinic acid is one of the most important metabolites present in fenugreek which is effective in diabetes and decreases the blood colesterol level.[11]

Apolipoprotein A-I is an important protein in colesterol intake from cells and its transfering to liver, which plays a major role in prevention of cardio-vascular deseases.[12]

Lipid abnormalities in diabetic patients include increased levels of trycliceride, total colesterol and LDL, decreased level of HDL, Apolipoprotein A-I and an increase in APO-B. These lipid changes as well as a higher level of oxidative stress lead to a greater risk of cardio vascular diseases [13,14]. Nowadays, researchers believe that diet and drugs, by themselves, are not enough to control and treat hyperglycemia and the lipid metabolism of diabetic patients, but, physical activity and exercise must be added to their daily program.[15] In addition to physical and physiologic benefits, exercise has mental, emotional and social advantages.[16]

Physical activities and exercise decrease glucose concentration and improve the blood levels of lipids through increasing suger intake by cells and activation of lipid metabolism[17, 18] For this reason, diabetic patients can take advantage of physical activities to better control their plasma levels of glucose, lipid profile, weight and the blood pressure. Different types of exercise training such as aerobic, resistance and elastic training could be prescribed for these patients [19]. But, among them, aerobic training is considered a critical component for treating T2DM patients[20], such that, American Diabetes Association(ADA) in 2002 has recommended aerobic training at 50-80% of maximal aerobic capacity, 4 sessions per week, each session 30-60 minutes .[21]

Different researches have inicated inconsistent findings and few research studied aerobic training effects associated with herbal plants consumption on the concentration of apolipoproteinA-I, an important factor in prevention of cardiovascular diseases. Also, there has been shown that a major fraction of diabetic patients (T2DM) die due to cardiac diseases. So conducting new researches in this field and for the purpose of investigating aerobic training and fenugreek consumption effects on diabetic patients seems to be necessary.

Material and Methods

This research isa semi experimental study with two experimental and one control group. The study population were female diabetic patients attending Shahid Ghoddusi health center, Mashhad, Iran. Of them, 30 volunters were selected according to the study's inclusion and exclusion criteria and their medical history. The inclusion criteria included presence of T2DM for more than 2 years, age 43, the blood glucose range of 200-300mg/dl and sedentary life style. Exclusion criteria included renal, cardio vascular, parathyroidous and digestive diseases and insulin consumption. Subjects administered metformin every day., The subjects were placed into 3 groups as follows:

Group 1(aerobic training): subjects in this group done aerobic training for 6 weeks, 3 sessions a week (with gradual a increase from 35 minutes in the initiuial sessions to 50 minutes in the final sessions). In each session, after stretching movements and mild running, subjects exercised at 60% (in the initial sessions) to 75% (in the last sessions) of their maximal heart rate. At the end of each session 10 minutes was spended to cooling down. The maximal heart rate was measured applying the formula (220-age) and training intensity was controled based on the calculated maximal heart rate.

Group 2(aerobic training+ fenugreek): subjects did aerobic training and took 3g of fenugreek every day and in form of prepared capsules.

Group 3 (control): subjects had no supplements and did not exercise. All subjets participating in this study were asked not to change their lifestyles (diet, activity). their diet and medicine were administered according to the recommended diet by the nutrition expert at the center for diabetes control. The first blood samplnig was done fbefore the beginig of the study's protocol , and all subjects were asked not to do intense activties 2 days before the sampling. The sampling was repeated 48 hours after the last training session. Measuring of lipid concentration (total colesterol and triglycerid) was done through colesterol oxidase and gliserol oxidase. HDL & LDL were measured through precipitation by polyanions. LDL & VLDL-C were measured applying Froyd & Wald method. Data were analyzed by Spss software (version 16). Quantitative data are represented as mean± standard deviation. Normality of Data distribution was determined by kolmogorov-smirnov, and homogeneity of variances was tested by Levene

test. Paired Sample T test was used to compare intra-group changes and Independent Sample T Test was applied for inter group changes.Tukey test was used for comparing paired groups. P<0.05 was considered as statistically significant.

Results

To analyze data, descriptive statistics was used to describe anthropometric charcteristics, means and standard deviations, and dependent and independent t tests were used to compare intra- and inter-group means, respectively. Differences between means of the three groups were studied by one-way ANOVA. All the statistical analyses were done using SPSS software (version …) and the significance level was set at P≤0.05.

Table 1: Apolipoprotein A-I level in the Aerobic training &Control Groups

Variable	N	Pre –test (SD±mean)	Post- test (SD±mean)	Intra-group changes	
				P	t
Aerobic Training	10	3.8 ±153.7	2.2 ±1 62.5	6.2	0.001
Control	10	± 156.9 3.6	4.4 ± 155.1	0.485	0.64

Table 2: Apolipoprotein A-I levels in Aerobic training+ fenugreek intake &Control Groups

Variable	N	Pre –test (SD±mean)	Post- test (SD±mean)	Intra-group changes	
				P	t
Aerobic Training+ fenugreek intake	**10**	**2.6± 154.6**	**2.7 ± 166**	**8.46**	**0.001**
Control	**10**	**3.6± 156.9**	**4.4± 155.1**	**0.485**	**0.64**

Table 3: pre- and post-test levels of the measured variables in the three groups.

measures	time	control	p	Aerobic training	p	Aerobic training+ fenugreek	p
Average LDL (mg/dl)	before	16 ± 100.00	0.036	± 14.4 153.16	0.826	±15.36 138.71	0.656
	after	± 10 154.4		± 18.7 151.3		± 14.36 132.14	
Average HDL (mg/dl)	before	2 ± 39.60	0.300	± 1 46.50	0.048	2 ± 40.00	0.048
	after	1 ± 36.80		± 2 51.00		47.42 ± 3	
Average FBS (mg/dl)	before	202.20 ± 11	0.128	19 ± 203.85	0.017	± 17.72 210.85	0.014
	after	203.85 ± 30		± 6.8 140.74		± 17.5 167.42	
Average TG (mg/dl)	before	204.6 ± 34	0.592	± 16 185.5	0.016	± 12 142.42	0.838
	after	235.6 ± 57.3		± 14.2 126.00		± 33 135.57	
Average TC (mg/dl)	before	± 19.50 187.60	0.110	± 15.3 193.3	0.280	± 8.77 151.00	0.488
	after	237.2 ± 14		± 18.9 175.5		143.00 ± 12.08	
Average of HDL/LDL	before	0.399 ± 0.5	0.109	0.314 ± 0.023	0.056	0.320 ± 0.05	0.045
	after	0.264 ± 0.031		± 0.038 0.362		0.387± 0.05	

According to table 1, it is shown that Apolipoprotein A-I levels in aerobic training group increased from 153.7±3.8 to 162.5±2.2, which was statistically significant, as compared to the control (p=0.001).

Table 2 shows that Apolipoprotein A-I levels in aerobic training+ fenugreek group increased from 154/6±2/6 to 166±2/7, which was a significant change (p=0/001).

Results presented in Table 3 show that average levels of LDL in the control group increased significantly in the post-test (p=0.036), but in the aerobic training and training+ fenugreek groups the change was not significant. Average concentration

of the post-test HDL decreased (p=0.3), but there was a significant difference between training and training+fenugreek groups (p=0.048).

Average concentration of FBS was not significantly different (p=0.128), but in aerobic training and training+ fenugreek groups it decreased significantly (p<0.05). In training group, average level of TG decreased significantly (p=0.016), but the change was not significant in training+ fenugreek group (p=0.838).

The average rate of HDL/LDL in aerobic training and training+ fenugreek groups increased significantly (p<0.05), but there was no significant difference between the training group and the control group.

Discussion and Conclusion

This research aimed to study the effects of aerobic training and fenugreek administration on the plasma apolipoprotein A-I concentrations of diabetic women. Results showed that concentration of apolipoprotein A-I in groups 1 and2 increased significantly after 6 weeks of aerobic training (p=0.001), which was consistent with the results from Lion et al. [22] who demonstrated that total concentration of TG & VLDL decreased and HDL-c and APO A-I increased after 20 weeks of aerobic training. Our results were also in line with those of Taylor et al., who, by studying effects of creatine ,fenugreek, and carbohydrate supplements on the adaptation to resistance training, indicated that there was a significant increase in lean body mass of CRF group. There are different factors which result in this situation such as subjects' nutrition and diet before and after trial, body fat percentage, inheritance, and differences in duration, intensity and frequency of training sessions, as well as age, sex and characteristics of the research samples. Impairment in glucose pick up, which is a phenomenon in diabetic patients, is generally resulted from impairment in GlUT-4 function or impaired in transferring insulin signals [23]. Contracted skeletal muscles have a great ability to pick up glucose from blood, which is independent from insulin influence. Exercise induces a transformation in Glut-4 and its transferring to cell membrane [24] and increases Glucose intake by the active skeletal muscles through protein carriers [25, 26]. Also, aerobic training has a positive effect because of the hormonal responses dependent on duration and intensity of the exercise and subject's diet and fitness level. Sympathetic neural system and catecholamines are the strongest driver of lipolysis. Epinephrine and norepinephrine levels induce HSL phosphorylation. Growth hormone and cortisol induce lipolysis. Insulin is the strongest inhibitor of lipolysis. Furthermore, levels of 17β-stradiol secretion increase in exercising women and results in increased consumption of lipid resources [27]). Among adaptations attained by aerobic training is increased volume of mitochondria and, in consequence, lipolysis enzymes activation such as lipoprotein lipase, an important enzyme for lipoprotein catabolism, and lecithin cholesterol aciltransferase [28]. Decreased activity of liver enzyme (HTGL) lead to LDLc fixation in sedentary people and decreased level of LPL facilitates LDLc formation and is associated with a greater level of HDL catabolism. The latter enzyme is important in HDL-c metabolism and cholesterol esterification. A greater level of ACAT causes cholesterol and phospholipids transformation to esterified cholesterol and a faster process of HDLC3 transformation to HDLC2 [29, 30]. Totally, regular exercise improves diabetes and prevents microvascular disorders such as nephropathy, neuropathy, and macrovascular disorders such as cardiac and arterial diseases [31]. The research results showed that levels of Apolipoprotein A-I in the training group increased significantly, as compared to the control group. (p=0.001). This change was also significant in training+ fenugreek group(p=0.001).

The average level of FBS between the two groups decreased significantly (p=0.05). FBS of the control group did not change significantly (p=0.128). Average of TG concentration decreased in group 1 (p=0.016), but this change was not significant in group 2 (p=0.838). The average concentration of LDL in the control group increased significantly (p=0.036). But this change was not significant in the other groups (aerobic training and aerobic training+ fenugreek). These findings were consistent with the findings of Aljamal et al., Mohebi et al., and Khal et al. [32, 33, 34]. Average concentration of HDL increased significantly (p=0.3). The average level of HDL changes showed a significant increase in groups1 and 2 (p<0.048). It may be that the increase in the HDL level be the result of increased level of lipoprotein lipase (LPL) enzyme activity. LPL is effective in VLDL transformation to HDL. And a greater level of its activity may decrease HDL-c. On the other hand,

lecithin cholesterol acyltransferase (LACT) also, transforms cholesterol to HDl. It may be that exercise training increased concentration of this enzyme [35]. It has been shown that LACT has significantly increased after exercise training. In this respect, there are other influencing mechanisms such as decreased level of insulin sensitivity which causes changes in the blood concentration of lipids and lipoproteins [36, 37]. The average rate of HDL/LDL increased in groups 1 and2. Apolipoprotein A-I is a useful protein in the plasma HDL. Also, it activates enzymes involving in lipids lipolysis such as LCAT and increases cholesterol picking from cells and its reverse transferring. It plays a major role in cholesterol homeostasis and prevention of cardiovascular diseases [38]. The plant antioxidants have insulin like effect and increase glucose intake in the peripheral tissues. Trigonilin nicotinic acid is one of the most important metabolites present in fenugreek extract which affects β cells and repairs injured cells and induces them to secrete insulin. Antioxidant components decrease lipids and lipoproteins through inhibiting cholesterol biosynthesis, inducing cholesterol transformation to bile acids, and increasing lipoprotein lipase enzyme activity. As a result cholesterol concentration, which is a constituent of lipoproteins, decreases and, as a result, lipoprotein synthesis decreases. On the other hand, LPL activation leads to lipoproteins decomposition and thus their decreased concentration [39]. All these result in a greater level of glucose absorption in peripheral tissues and increased level of insulin sensitivity which is effective in diabetes treatment. So, it seems that aerobic training associated with fenugreek administration has a better effect on lipoproteins, especially Apolipoprotein A-I. In conclusion, results from the present study indicated that 6 weeks of aerobic training along with fenugreek administration could have useful effects on improving lipoprotein levels and decreasing the blood levels of glucose in diabetic patient (T2DM). So, these patients can take advantage of aerobic training, according to the recommended protocol, and make use of fenugreek intake, along with their drugs, to control their blood lipid profiles, and have a healthier life.

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