ISSN 2582 – 6050

Available Online at www.ijpba.info
International Journal of Pharmaceutical & Biological Archives 2023; 14(1):45-50

RESEARCH ARTICLE

The Deposition of Cholesterol in Blood Vessels May Lead to Blood Clotting: Coronary Artery Disease

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Received: 25 January 2023; Revised: 12 February 2023; Accepted: 05 March 2023

ABSTRACT

In the body, liver produces approximately 80% of the cholesterol whereas rest of the cholesterol is obtained from the food such as fish, eggs, and meat. After having a meal, cholesterol is digested and absorbed in small intestine then the metabolism and storage occurred in the liver. The cholesterol may be secreted by the liver whenever the requirement of cholesterol is needed by the body. Cholesterol is not present in the food which is derived from the plants. We in this study have compared hypolipidemic effects of Fenugreek, Curcuma longa, and Lemon. The study was conducted at Jinnah Hospital Lahore-Pakistan from January to May 2019. Ninety hyperlipidemic patients of age group 19–70 were included in the study. Exclusion criteria were diabetic, alcoholic additives, hypertensive patients, and those whose kidney or liver functions were impaired. Consent was taken from all participants. Their base line lipid profile was taken in biochemistry laboratory of the hospital. They were divided in three groups, that is, 30 patients in each group. Group-I was advised to take 500 mg of Curcuma longa (haldi) mixed in fresh milk without cream, thrice daily for 2 months. Group-II patients were advised to take 100 g of Fenugreek leaves mixed with salad in each meal (thrice daily) for the period of 2 months. Group-III patients were advised to take 40 mL of fresh lemon juice mixed with 40 mL mineral water thrice daily for 2 months. They all were advised not to take heavy meal rich with any type of fat like junk food. One h daily brisk walk was advised to all participants. Fifteen-day follow-up visit was scheduled for them. After 2 months, their lipid profile was redetermined. When results were compiled and statistically analyzed by applying paired "t" test, it revealed that Curcuma longa decreased total cholesterol (TC), triglycerides (TG), low density lipoprotein (LDL) cholesterol 16.10, 20.01, and 17.59 mg/dL, respectively. Fenugreek decreased TC, TGs, and LDL cholesterol 14.70, 17.33, and 17.06 mg/dL, respectively. Lemon in 2 months therapy decreased TC, TGs, and LDL cholesterol 15.45, 10.13, and 11.97 mg/dL, respectively. None of the above mentioned herbs raised High density lipoprotein (HDL) cholesterol significantly. It was concluded from this research work that Curcuma longa, Fenugreek leaves and Lemon are mild-to-moderately effective hypolipidemic herbs to lower total plasma cholesterol, TG, and LDL cholesterol but have no potential to raise HDL cholesterol when analyzed biostatistically.

Keywords: CAD, Haldi, Hyperlipidemia, Lemon, Methi, Plants, Prevention and cure

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INTRODUCTION

The deposition of cholesterol in blood vessels may lead to blood clotting and if it breakdown and goes

through the blood toward the heart then it may leads to cardiac arrest and if it enters the brain then it may increase the chances of stroke. The main etiology of elevated cholesterol in blood is high intake of several saturated fats. Cholesterol is attached or carried by lipoproteins as it cannot travel freely in the blood. Atherosclerotic problems are encountered with enhancement of low density lipoprotein (LDL) uptake by monocytes and macrophages.[1,2] In the liver, uptake of plasma LDL is mediated via specific LDL receptors, but a scavenger receptor system is employed by macrophages. Plasma LDL must be modified prior to uptake by macrophages. Analysis of the lipid content in the oxidatively modified LDL from hyper lipidemic patients revealed that the level of lysophosphatidylcholine was greatly elevated, and the high level of the lysolipid was shown to impair the endothelium-dependent relaxation of the blood vessels.[3-7] In allopathy blood lipid levels are normalized by statins, fibrates, niacin, and bile acid binding resins (BABRs). All of these allopathy-related drugs have low compliance ranges from mild compliance due to metalic taste of BABRs to severe side effects like rhabdomyolysis by fibrates and statins.[8] Due to low compliance and adverse effects of conventionally used hypolipidemic agents, herbal medicines are going to be famous among physicians and cardiologists.[9] Medicinal herbs such as Curcuma Longa, Fenugreek, and Lemon contents are being used as mild to moderate hypolipidemic agents. Curcuma Longa commonly known as Haldi in India and Pakistan is used to lower plasma lipids, in view of their contents. It contains Curcuminoids (curcumin, demethoxycurcumin, and bisdemethoxycurcumin), turmerone, atlantone, zingiberene, proteins, and resins.[10] Curcumin reduces both the oxidation and circulation of oxidized levels of LDL cholesterol which leads to reduction in the occurrence or treatment of already present atherosclerosis in the subjects.[11] Research has revealed that curcumin from turmeric is an extremely efficient agent in increasing cholesterol uptake by the liver cells.[12] Several independent studies have shown that curcumin increases the expression of cholesterol and lipoprotein receptors on the liver cells.[13] Curcumin also increases cholesterol and bile acids excretion in feces.[14] In addition, curcumin also increases the amount of ATP-binding cassette (ABC) transporters. These transporters are basically involved in flushing out excess cholesterol from the inside of the macrophages. When the numbers of ABC transporters are increased on the surface of a macrophage, the deposited cholesterol is effluxes out through these channels again into the blood. Through the blood, it reaches liver where it is metabolized efficiently.[15] The composition of fenugreek includes a large number of chemical components. They include proteins and amino acids, flavonoids, saponins and steroidal saponins, coumarin, lipids, vitamins, minerals, galactomannan fiber, and alkaloids, such as trigonelline. Extracts are available standardized to contain 50% saponins or 20% of the amino acid 4-hydroxyisoleucine.[16] Treatment with fenugreek. Seed powder normalized the enhanced lipid peroxidation and increased susceptibility to oxidative stress associated with depletion of antioxidants.[17] The steroidal saponins (diosgenin, yamogenin, tigogenin, and neotigogenin) are thought to inhibit cholesterol absorption and synthesis and hence its potential role in arteriosclerosis.[18] Phenolics in Curcuma Longa have potential health benefits mainly due to their antioxidant properties such as reactive oxygen species scavenging and inhibition, electrophile scavenging and metal chelation.[19] Epidemiological studies support a relationship between the consumption of phenolic rich food products and a low incidence of coronary heart disease, atherosclerosis, certain forms of cancer, and stroke.[20] Lipid peroxidation is inhibited by flavonoids and flavanones present in lemon.[21]

PATIENTS AND METHODS

The research work was conducted at Jinnah Hospital, Lahore from January to May 2019 with approval of Research Ethics Committee of the Hospital.

Sample Size

Ninety hyperlipidemic patients were selected for research work.

Consent

Written consent was taken from all patients. Specific Performa was designed for the research work. Hyperlipidemic patients were selected with age range from 19 to 70 years.

Exclusion Criteria

Exclusion criteria were hypertension, hypothyroidism, diabetes mellitus, alcohol addictive patients, peptic ulcer, any gastrointestinal upset, renal impairment, and any hepatic or cardiac problem.

Grouping

All patients were divided in three groups (Group-I, Group-II, and Group-III), 30 patients in each group. Their baseline lipid profile data were taken and filed in specifically designed Performa, at start of taking medicine, such as lipid profile, blood pressure, and pulse rate.

Lipid Profile

Serum lipid profile (total cholesterol [TC], High density lipoprotein [HDL-cholesterol], triglyceride) parameters were determined after a 12 h overnight fast by standard methods. LDL-cholesterol level was calculated according to the Friedewald's formula. Thirty patients of Group-I were advised to take 500 mg of *Curcuma longa* (Haldi) mixed in fresh milk without cream, thrice daily for 2 months. Group-II patients were advised to take 100 g of Fenugreek leaves mixed with salad in each meal (thrice daily) for the period of 2 months. Group-III patients were advised to take 40 mL of fresh lemon juice mixed with 40 mL mineral water thrice daily for 2 months. They all were advised not to take heavy meal rich with any type of fat like junk food. One h daily brisk walk was advised to all participants. Fifteen-day follow-up visit was scheduled for them. After 2 months, their lipid profile was redetermined.

Statistical Analysis

Mean values of the day-0 and day-60 of tested parameters (TC, LDL cholesterol, triglycerides (TG), and HDL cholesterol) ± SD were taken to be analyzed statistically. SPSS 10 version 2.00.01.10 was used to analyze pre-treatment and post-treatment values of all parameters. Paired "t" test was applied to determine changes in pre- and post-treatment values. $P > 0.05$ was considered as non-significant changes in tested parameters, and $P < 0.01$ was considered as significant changes.

RESULTS

Hyperlipidemia is abnormally elevated levels of any or all lipids or lipoproteins in the blood. It is the most common form of dyslipidemia (which includes any abnormal lipid levels). When results were compiled and statistically analyzed using SPSS 10 version 02.00.01.10, it revealed that curcuma longa decreased TG), TC, and LDL cholesterol of 29 hyperlipidemic patients 20.01, 16.10, and 17.59 mg/dl, respectively. Raise in HDL cholesterol in this group was 03.70 mg/dl. Fenugreek leaves reduced TG, TC, LDL cholesterol of 28 hyperlipidemic patients 17.33, 14.70, and 17.06 mg/dl, respectively. Lemon juice reduced TC, TG, and LDL cholesterol 15.45, 10.13, and 11.97 mg/dl, respectively. HDL raised 03.55 mg/dl in this group. Changes in all tested parameters and their statistical significance are shown in following table. Tables 1, 2, and 3 are self explanatory and shows values of total cholesterol (TC), triglycerides (TG), low density lipoprotein cholesterol (LDL-C) and high density lipoprotein cholesterol (HDL-C) before and after treatment. Statistical significance in change of values (p-value) is described against each tested parameter of lipid profile.

DISCUSSION

Modern primary care practitioners spend considerable time and effort on preventative medicine. Diagnosing and managing hyperlipidemia as a way to prevent cardiovascular disease (CVD) is a common activity for primary care physicians.

According to Centers for Disease Control data from a survey of 1492 physicians who provide ambulatory care in non-government settings, hyperlipidemia is second only to hypertension in the list of the 10 most common chronic conditions that were seen. Cholesterol is a fatty substance that is carried around the body in the blood. The body produces most cholesterol naturally, and it is found in some foods. Lipoproteins carry cholesterol in the blood. The two main types that carry cholesterol to and from cells are called LDL-C and HDL-C. The lower the density of the lipoproteins the more fats it contains. HDL cholesterol is called the "good cholesterol" because it helps to keep cholesterol from building up in the arteries. LDL cholesterol is called the "bad cholesterol" because it is the main source of cholesterol build-up and blockage in the arteries. Statin medication work to reduce this LDL-C. In our results lemon, curcula longa, and Fenugreek proved that significant reduction occurs in TC, TG, and LDL cholesterol using these herbal preparation/ mixture. However, all of these three herbs have no significant influence on HDL cholesterol. Same results did prove in the study conducted by Wiseman *et al*.,[22] who described that pectin present in these three herbs inhibit enterohepatic circulation of bile acids and excrete cholesterol in feces. Flavenoids present in Fenugreek are responsible for inhibition of cholesterol synthesis.[23] Gidez *et al*.,[24] stated that herbal medications have more than one or two mechanism to balance plasma lipids in hyperlipidemic patients. Bingham *et al*.,[25] stated that the major reasons for hypercholesterolemia in today's world are obesity, consuming high fat food, diabetes, and having a family history of high cholesterol. This disorder is reported to affect a large number of people all across the world and is one of the leading causes of death as well. Cholesterol is reduced in the body by managing weight and diet. Regular exercise, lesser consumption of fatty foods, more consumption of fruits and vegetables help in ameliorating the symptoms of hypercholesterolemia. However, in most cases, medications also known as anti-hypertensive and anti-cholesterol drugs are also required, especially in chronic cases. There are several problems associated with medications though and people are now switching toward newer and less toxic therapies to control and reduce cholesterol levels

Table 1: Parameters values before and after treatment with their statistical significance in Group-1 (*n*=29) (*Curcuma longa* or haldi)

Values before treatment	Values after treatment	Difference	*P*-value
TC at day-0 271.87±1.04	TC at day-60 255.77±2.77	16.10	≤0.001
TG at day-0 216.09±2.43	TG at day-60 196.08±2.45	20.01	≤0.001
LDL-C at day-0 179.65±2.87	LDL-C at day-60 162.06±2.51	17.59	≤0.001
HDL-C at day-0 37.95±1.45	HDL-C at day-60 41.65±1.91	3.70	≤0.001

KEY: All values are written in mean and±stands for standard error of mean. T-C: Serum total cholesterol, TG: Serum triglycerides, LDL-C: Low density lipoprotein cholesterol, HDL-C: High density lipoprotein cholesterol. All parameters pre and post-treatment are measured in mg/d. *n*: Sample size. *P*<0.01 stands for significant change, *P*>0.05 stands for non-significant change

Table 2: Parameters values before and after treatment with their statistical significance in group-2 (*n*=28) (Fenugreek or Methi)

Values before treatment	Values after treatment	Difference	*P*-value
TC at day-0 280.56±1.06	TC at day-60 265.86±2.65	4.70	≤0.001
TG at day-0 224.87±1.55	TG at day-60 207.54±1.98	17.33	≤0.001
LDL-C at day-0 213.13±2.78	LDL-C at day-60 196.07±1.56	17.06	≤0.001
HDL-C at day-0 35.19±2.32	HDL-C at day-60 38.08±1.67	2.89	≤0.001

KEY: All values are written in mean and±stands for standard error of mean. T-C: Serum total cholesterol, TG: Serum triglycerides, LDL-C: Low density lipoprotein cholesterol, HDL-C: High density lipoprotein cholesterol. All parameters pre and post-treatment are measured in mg/d. *n*: Sample size. *P*<0.01 stands for significant change, *P*>0.05 stands for non-significant change

Table 3: Parameters values before and after treatment with their statistical significance in Group-3 (*n*=29) (Lemon water)

Values before treatment	Values after treatment	Difference	*P*-value
TC at day-0 258.21±2.12	TC at day-60 242.76±1.89	Difference 15.45	≥0.05
TG at day-0 246.56±2.11	TG at day-60 236.43±2.43	10.13	≥0.05
LDL-C at day-0 179.08±2.87	LDL-C at day-60 167.11±1.77	11.97	≥0.05
HDL-C at day-0 36.22±1.77	HDL-C at day-60 39.77±1.55	3.55	≥0.05

KEY: All values are written in mean and±stands for standard error of mean. T-C: Serum total cholesterol, TG: Serum triglycerides, LDL-C: Low density lipoprotein cholesterol, HDL-C: High density lipoprotein cholesterol. All parameters pre- and post-treatment are measured in mg/d. *n*: Sample size. *P*<0.01 stands for significant change, *P*>0.05 stands for non-significant change

in the body. Several natural herbs, supplements, and food products are known to maintain healthy cholesterol levels and reduce cholesterol in mild hypercholesterolemia. These therapies, if opted for, help in preventing the disorder but are less helpful in chronic cases of this disease. In an experiment,[26] controlled dosing of turmeric was used to feed hypercholesterolemic rabbits and the effects on LDL oxidation was analyzed. It was found that turmeric extracts efficiently and quickly reduced the levels of cholesterol in the blood along with the incidences of atherosclerosis with time. The reason for these therapeutic effects, when analyzed, was found to be the preventive action of turmeric on the oxidation of LDL cholesterol. Mattern *et al*.,[27] have also explained same important mechanism of action of Turmeric that oil of these seeds inhibits enterohepatic circulation causing biosynthesis of bile acids instead of cholesterol by hepatocytes. The results obtained from research work conducted by Geleijnse *et al*.[28] revealed that all extracts of the fenugreek exhibit antioxidant activity. These findings suggest that the fenugreek extracts could act as potent source of antioxidants. Magee *et al*.[29] mentioned that many herbs and their constituents have potential to reduce total plasma cholesterol LDL cholesterol, and TG but they do not raise HDL cholesterol because it needs special plasma proteins as lipoproteins responsible for structural and functional integrity of HDL particles. The fact that hyperlipidemia is a strong risk factor for CVD is well established. Hyperlipidemia refers to elevated cholesterol, elevated TG or both. The problem can be due solely to hereditary factors, but more commonly, it is an acquired condition. Physicians need to know the major categories of dyslipidemia and to have a well-reasoned action plan for dealing with each one, including knowing when to refer a case to a lipidology specialist. It is the purpose of this paper to review the categories of hyperlipidemia, the current treatment recommendations and the current controversies and unresolved questions.[30-36]

CONCLUSION

We concluded from this research work that Curcuma longa, Fenugreek leaves and Lemon have hypolipidemic potential to decrease total cholesterol, triglycerides, low density lipoprotein cholesterol when used for two months. These herbs do not raise high density lipoprotein cholesterol when used for two months.

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