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The Hypolipidemic Effect of Ginger and Fenugreek in Rats

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Abstract

Hyperlipidemia is one of the most important risk factors for liver diseases and atherosclerosis. This study was used to evaluate the effect of hypolipidemic agents on some biochemical parameters such as total lipids, total cholesterol, triglycerides, low density lipoproteins (LDL), very low density lipoproteins (VLDL), high density lipoproteins (HDL), lecithin cholesterol acyltransferase enzyme (LCAT), apolipoprotein B (ApoB), phospholipids and serum glucose level. Animals were divided into four groups (1st group was left without treatment as control, while 2nd group was hyperlipidemia group; fed with high fat diet [HFD] for 9 weeks. Other 2 groups were treatment groups as [HFD + ginger 400 mg/kg], [HFD + fenugreek extract 200 mg/kg] daily orally for 5 weeks. Blood samples and tissue specimens from liver were collected after 6 and 9 weeks. Results of treatment revealed significant decrease in lipid parameters and glucose level while obtained increase in HDL. Therefore, the differences of hypolipidemic agents such as ginger and fenugreek were estimated by evaluation the different biochemical parameters.

Keywords: ApoB, Fenugreek , Ginger, Hyperlipidemia, LCAT.

1. Introduction

Hyperlipidemia is a healthcare problem which aggravates a lot of diseases as mainly cause elevation of lipid profiles and hepatic enzymes [20] resulting in cardiovascular diseases [8] in human. Also many experiments made on animals [18] showed an atherogenic effect [23] and some pancreatic and kidney diseases [32]. Hyperlipidemia can be improved by many ways such as synthetic medications such as statins (HMG-CoA reductase inhibitors) [26], fenofibrates [27] or medicinal plants such as fenugreek [29], ginger [28], in addition to curcumin [25], artichoke [30,31]. Therefore, this study was designed to investigate the variable differences of ginger and fenugreek effects on lipid profiles and glucose parameters after experimentally induced hyperlipidemia in rats.

2. Materials and methods

2.1 Animals

56 male Albino rats (200-250) g body weight were obtained from the Animal House, Faculty of Veterinary Medicine, Benha University, Egypt; stored at room temperature, well-ventilated area and were fed a standard diet for one week (adaptation period). Rats were divided into four groups housed in separate cages. Diet and water were offered daily ad libitum.

2.2 Materials

2.2.1 Animal fat

Animal fat was added to diet (17 g fat + 3 g corn oil/100 g diet) [15].

2.2.2 Cholesterol powder

Cholesterol powder was obtained from Al Gomhorya Company, Egypt.

Cholesterol was added at concentration 1% [4], it was dissolved in liquefied fat before adding to diet.

2.2.3 Cholic acid

Cholic acid powder was obtained from Euromedex Company, France. It was added at concentration 1%, dissolved in liquefied fat before adding to diet to enhance absorption of cholesterol [22].

2.2.4 Ginger (Zingiber officinale Roscoe)

Ginger tablets were obtained from Mepaco Company, Egypt. Ginger (aqueous solution) was taken at concentration (400 mg/kg B.wt daily orally) [7].

2.2.5 Fenugreek (Trigonella foenum Graecum)

Fenugreek was extracted according to [9] as fenugreek seeds were dried then homogenized to fine powder. The powder was soaked in aqueous 70% ethanolic solution 1:3 (plant weight: solvent volume) in soxhlet apparatus for 5 days at room temperature with occasional shaking, then the solvent was filtered, evaporated under reduced pressure. The extract yield was 20% stored at -20ºC till use. Fenugreek extract aqueous solution was taken at concentration (200 mg/kg B.wt daily orally) [3].

2.3 Biochemical analysis

Serum samples were collected from retro orbital bleeding on plain/gel tubes after 6 and 9 weeks of experiment for estimation total cholesterol [5], triacylglycerol [36], HDL [5], LDL [34], VLDL [34], LCAT enzyme [6], phospholipids [35] and apo B [4], as well as blood glucose level [35].

2.4 Statistical analysis

Statistical analysis was performed using the statistical software package SPSS. The significance of differences among the four groups was evaluated by one-way analysis of variance (ANOVA). Results were expressed as the mean (±) standard error of

mean (SEM). A p-value of less than 0.05 was considered significant [16].

3. Results

3.1 Changes of lipid parameters

There was a significant increase(p<005) in hyperlipidemic group in lipid parameters including (total cholesterol, triglycerides, VLDL, LDL, total lipids, phospholipids, LCAT and ApoB level, while HDL revealed a significant decrease after 6 and 9 weeks compared to control group as illustrated in Tables (1, 2). But ginger and fenugreek groups indicated a significant decrease in triglycerides, VLDL and total lipids levels without significant changes on total cholesterol LDL and HDL levels after 6 weeks compared to hyperlipidemic group. On the other hand, a significant decrease indicated in total cholesterol, triglycerides, LDL, VLDL, total lipids, phospholipids, LCAT and ApoB in ginger and fenugreek groups after 9 weeks, while HDL level was increased after 9 weeks comparing with hyperlipidemic group as shown in tables (1, 2).

Phospholipids, LCAT and ApoB levels after 6 weeks; ginger group showed significant decrease compared to hyperlipidemic group, while fenugreek group showed non-significant decrease in phospholipids, LCAT and ApoB levels comparing with the hyperlipidemic group. On the other hand, after 9 weeks; ginger and fenugreek groups showed significant decrease in LCAT level in comparison with hyperlipidemic group. Ginger treated group demonstrated a significant decrease in phospholipids level after 9 weeks in comparison with fenugreek group. Tables (1, 2)

Table (1) Lipid Profiles and glucose changes after 6 weeks: (mean ± Sf)

TEST	Control	Hyperlipidemic(H)	H + Ginger	H + Fenugreek
Total cholesterol (mg/dl)	63.80 ± 3.57^{a}	96.80 ± 2.46^{b}	90.20 ± 0.86^{b}	90.60 ± 1.29^{b}
Triglycerides (mg/dl)	91.20 ± 6.89^{a}	158.60 ± 5.77^{c}	95.20 ± 4.14^{a}	97.40 ± 5.17^{a}
HDL (mg/dl)	35.80 ± 2.11^{b}	20.76 ± 1.57^{a}	27.60 ± 2.06^{ab}	26.97 ± 2.01^{ab}
LDL (mg/dl)	9.76 ± 1.72^{a}	44.32 ± 3.84^{b}	43.96 ± 1.68^{b}	44.15 ± 1.40^{b}
VLDL (mg/dl)	18.24 ± 1.38^{a}	31.72 ± 1.15^{c}	19.04 ± 0.83^{a}	19.48 ± 1.03^{a}
Total lipids (mg/dl)	415.0 ± 8.26^{a}	535.4 ± 6.45^{d}	445.4 ± 4.56^{b}	448.0 ± 5.54^{b}
Phospholipids (mg/dl)	170.33 ± 6.47^{a}	299.10 ± 5.15^{c}	258.38 ± 17.49^{b}	290.18 ± 11.91^{c}
LCAT (µg/mg)	33.26 ± 5.60^{a}	60.56 ± 1.43^{c}	53.51 ± 2.55^{b}	58.93 ± 2.05^{bc}
Apo B (ng/mL)	40.71 ± 2.29^{a}	96.20 ± 3.16^{d}	88.41 ± 2.86^{c}	93.73 ± 2.15^{cd}
Glucose (mg/dl)	116.00 ± 5.01^{a}	122.20 ± 4.15^{a}	121.00 ± 2.28^{a}	116.40 ± 6.22^{a}

a, b & c: Superscripts to be compared statistically within the same row. Values with different superscripts are significantly different (P<0.05).

Table (2) Lipid Profiles and glucose changes after 9 weeks

TEST	Control	Hyperlipidemic(H)	H + Ginger	H + Fenugreek
Total cholesterol(mg/dl)	60.40 ± 2.91^{a}	129.20 ± 2.22^{c}	93.20 ± 1.56^{b}	96.80 ± 4.91^{b}
Triglycerides (mg/dl)	95.20 ± 11.62^{a}	207.20 ± 13.63^{c}	159.20 ± 4.26^{b}	98.60 ± 8.80^{a}
HDL (mg/dl)	33.40 ± 2.46^{d}	16.60 ± 0.81^{a}	28.40 ± 1.44^{c}	24.60 ± 2.04^{b}
LDL (mg/dl)	7.96 ± 0.89^{a}	71.16 ± 2.77^{e}	32.96 ± 2.29^{c}	52.88 ± 6.03^{d}
VLDL (mg/dl)	19.04 ± 2.32^{a}	41.44 ± 2.73^{c}	31.84 ± 0.85^{b}	19.72 ± 1.76^{a}
Total lipids (mg/dl)	415.6 ± 13.10^{a}	596.4 ± 14.18^{c}	512.4 ± 5.49^{b}	455.8 ± 10.49^{b}
Phospholipids (mg/dl)	166.0 ± 4.73^{a}	365.0 ± 12.12^{e}	200.67 ± 10.35^{b}	272.0 ± 9.54^{d}
LCAT (µg/mg)	28.26 ± 3.35^{a}	66.06 ± 1.41^{d}	37.96 ± 2.60^{b}	49.02 ± 4.13^{c}
Apo B (ng/mL)	41.47 ± 1.30^{a}	125.67 ± 2.96^{e}	66.53 ± 4.18^{c}	84.73 ± 1.98^{d}
Glucose (mg/dl)	119.80 ± 3.80^{bc}	126.80 ± 3.04^{c}	118.20 ± 3.31^{b}	100.20 ± 2.35^{a}

a, b & c: Superscripts to be compared statistically within the same row. Values with different superscripts are significantly different (P<0.05).

3.2 Serum glucose parameter

Concerning to serum glucose level, hyperlipidemic group in addition to ginger and fenugreek treated groups revealed non-significant changes after 6 weeks compared to control group. On the other hand, the hyperlipidemic group showed non-significant increase in serum glucose level after 9 weeks comparing to the control group, while all treated groups significantly decreased the glucose level after 9 weeks comparing with the hyperlipidemic group. Fenugreek group significantly decreased the glucose level after 9 weeks comparing with ginger group. Tables (1, 2).

4. Discussion

Total lipids, cholesterol and triglycerides levels revealed a significant increase in hyperlipidemic group comparing with the control group. These results agree with [23,24] who stated that total lipids & cholesterol were increased due to their absorption from intestine to circulation where triglycerides and cholesterol turned into acute fatty

changes in liver due to intracellular lipid accumulation [23]. Ginger treated group showed in total lipids, cholesterol and triglycerides levels a significant decrease compared to hyperlipidemic group. These results agree with [13] in addition to [38,17] who indicated that the hypolipidemic effect of ginger was attributed to stimulation the conversion of cholesterol to bile acids and inhibition pancreatic lipase enzyme as well as inhibition cellular cholesterol biosynthesis. Also the presence of many antioxidative compounds like gingerols, shogaols, phenolic ketone derivatives, volatile oils and flavinoids in ginger, these antioxidant compounds modulate the antioxidant enzymes. On the other hand, fenugreek treated group illustrated that total lipids, cholesterol and triglycerides levels were decreased significantly comparing with the hyperlipidemic group. These results agree with [21,3]. [21] illustrated that fenugreek lead to delayed onset of cholesterol crystallization. Fenugreek supplementation to high cholesterol diet reduced the cholesterol crystallization factor, increased bile secretion, biliary phospholipids and bile acids, prolonged the cholesterol nucleation time, and decreased the vesicular form of cholesterol. Furthermore, [3] indicated that the hypolipidemic action of fenugreek extract was caused by delaying lipids and carbohydrates absorption as a result of bioactive fibers existing in fenugreek seeds. Also fenugreek seeds decreased ApoB and LCAT enzyme as well as phospholipids level which playing an important role in cholesterol synthesis.

LDL, VLDL and HDL levels in hyperlipidemic group showed a significant increase in LDL and VLDL level, while it decreased the level of HDL compared to control group. These results agree with [33]. The increased LDL and VLDL were due to increase levels of triglycerides & cholesterol [24]. Ginger and fenugreek treated groups showed a significant decrease in LDL and VLDL levels, while HDL level was increased compared to hyperlipidemic group. The results of ginger agree with [38,17,13] that were due to decreased level of LDL-receptor and inhibition of hepatic fatty acid synthesis [13]. While results of fenugreek agree with [25,3] that were due to decrease cholesterol content of the bile by increasing bile secretion [21].

Concerning to LCAT, phospholipids and ApoB levels; hyperlipidemic group showed a significant increase compared to control group, these results agree with [11], Hyperlipidemia enhanced the body to increase L-CAT enzyme which was enzyme responsible for lipid metabolism cc6[12]. Ginger and fenugreek treated groups significantly decreased the levels of LCAT, phospholipids and ApoB when compared to the hyperlipidemic group, the results of ginger agree with [19,11] that were due to decreased level of LDL-receptor which was responsible for decreased clearance of apo B along with LDL and VLDL levels [10]. In addition, the results of fenugreek agree with [25,3]. There was a relationship between LCAT and LDL and HDL levels as the increase of LCAT was due to the lowering of plasma HDL level [7].

Concerning to results of serum glucose level; hyperlipidemic group indicated non-significant increase in serum glucose level compared with control group; these results agree partially with [2] who found a significant hyperglycemia due to glucose-fatty acid cycle where the high free fatty acids reduced the glucose uptake and utilization through the increased endogenous glucose production. On the other hand, ginger and fenugreek treated groups showed significant decrease in serum glucose level compared to hyperlipidemic group. Results of ginger treated group agree with [17,13] who stated that ginger might be exerting insulin-like effect on peripheral tissues by promoting glucose uptake, inhibiting hepatic gluconeogenesis or increased entrance of glucose into the muscle and adipose tissues through the stimulation of glucose transporter gene expression "Glut-4" and stimulation of a regeneration process of the remaining β-cells [14] in addition to gingerols inhibit α–glucosidase and α–amylase enzymes. While fenugreek group results agree with [3,1]. The cause of reduction was attributed to slow release carbohydrate and increase the soluble fiber, which helped lower blood sugar by slowing down digestion and absorption of carbohydrates. Fenugreek seeds contain galactose and mannose which were associated with reduced hyperglycemia and hypercholesterolemia, also fenugreek had insulinotropic effect. Also [3] indicated that saponin, alkaloids and trigonelin of fenugreek extract caused control of intestinal absorption of glucose under lab conditions.

5. Conclusion

Hypolipidemic and hypoglycemic effects were significant in ginger and fenugreek treated groups compared to hyperlipidemic group; therefore, we recommend with administration of medicinal plants such as ginger and fenugreek that could ameliorate the disturbance caused by hyperlipidemia without the disadvantages of chemically synthetic drugs.

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