

Effect of Apple (*Malus domestica*) Supplementation on Serum Lipids and Lipoproteins Level in Cholesterol-Fed Male Rat

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Abstract: Hypercholesterolemia is one of the risk factors of cardiovascular diseases and high blood cholesterol continuing challenge of public health and increase of mortalities due to cardiovascular disease. High intake of fatty diet results in elevated cholesterol, LDL and down regulates LDL receptors in liver. Several evidences suggest that antioxidants consumption controls hypercholesterolemia. The health benefits of fruits and legumes are now widely recognized. It has been estimated that the fiber in apple plays a major role in its lipid lowering capacities. This study clarified the effect of apple supplementation on blood lipid level in cholesterol-fed male rat. Three groups of male rat (ten each) were used. The first (G1) was Control group, consumed chow (basic) diet. The second (G2) and third (G3) groups consumed two percent cholesterol in diet. G3 consumed apple (20%) for one month beside the fatty diet. After one month, TC, LDL, TG and HDL concentrations were measured. In G2 TC, LDL and TG (but not HDL) concentrations significantly increased ($p < 0.05$) compared with control group G1. Supplementation of apple in G3 decreased ($p < 0.05$) TC and LDL concentrations compared with G2. This effect of apple may be related to antioxidant effects of this agent. However, further investigation is recommended to evaluate the hypolipidemic effect of Apple is given to Obese people.

Key words: Hypercholesterolemia • Lipids And Lipoproteins Levels • Apple Supplementation • Male Rat

INTRODUCTION

Hyperlipidemia is one of the main causes of half of deaths from cardiovascular disease. Cholesterol increased public health endanger [1, 2]. Hypercholesterolemia is observed in most industrial societies where poor nutrition with food containing saturated fats and cholesterol is high. Since heart disease in our country is common in vascular-induced hypercholesterolemia, in this case study seems necessary. Poor nutrition with high cholesterol increases the cholesterol level, LDL and triglycerides and decreases HDL. On the same time other hand hypercholesterolemia decreases LDL receptors in the liver and increased triglyceride and cholesterol levels and reduces HDL [3, 4]. The elevated increased LDL and decreased HDL in serum is one of the main factors involved in heart disease, coronary atherosclerosis, especially, the, development that causes of inflammation

of the and endothelial lining of blood vessels leading to function and reduction in vascular lesions is wide [5]. Oxidation of Lipoprotein LDL of vessels, increases cardiovascular disease. Increased serum HDL (unlike LDL) could progress of hypercholesterolemia and heart disease may prevent vascular [4-6]. Atherosclerosis is one of the diseases that can be caused by various factors (a Multifactorial Diseases). Factors in the incidence of the disorder are genetic and or environmental factors effects and their interactions on each other and may be incriminated in contribute to their effects mainly by the changes of serum lipids and lipoproteins leading to appear that finally caused cardiac artery disease [2, 4, 5, 7]. It has been found that consumption of antioxidant nutrients decreased coronary-induced hypercholesterolemia and heart disease in humans and experimental animals [8-15]. Apple scientific name (*Malus Domestica*), a family of cold fruit trees of

different type. Containing large quantities of potassium, sodium, calcium, iron and phosphorus and high amounts of vitamin A, B and C are. It is reported that apple contains 20-25% of daily needs of polyphenol compounds and 10-30% of the daily fiber needed by your body [17, 19, 21-23]. Previous studies showed that about 50% of the fiber pectin found in apples is effective in modulation of lipid metabolism where poly galacturonic acid in pectin which lowers the plasma cholesterol [9, 12, 14, 17, 19, 20, 25-31]. Researchers referred the cholesterol-lowering effect of apple in the plasma and liver to antioxidant effect [11, 13, 24, 31]. The aim of this study was to investigate of the effect of supplementation with apple on Lipid and lipoproteins serum levels in male rats fed with high cholesterol.

MATERIALS AND METHODS

In this study 30 Wistar rats (250-300 gm /body weight) were purchased from breeding and maintaining laboratory animals Center of Islamic Azad University of Tabriz had been used. (n=10 for each group) Animals had free access to food and water Animals were randomly divided into three groups (ten each). First group G is control group (receiving basal diet). The second group is G2 received dietary cholesterol 2% ration [7, 32]. The third group G3 received apple 20% of diet beside the fatty diet the same as G2, Animals fed these rations for one month. At the end of the experiment animals were fasted and sacrificed. Blood samples were taken from the animals studied. Centrifuge blood samples for serum were preparing. Isolated from the serum total cholesterol (TC), high density lipoprotein (HDL) and triglyceride (TG) were measured. Low density lipoprotein (LDL) using the Friedewald-Frederickson formula as mg/dl was calculated ($LDL=TC-HDL-TG/5$) [33]. Data were computed using one-way ANOVA followed by Tukey multiple comparison tests was used. Value of $p<0.05$ to determine the level was considered significant.

RESULTS

Results showed that concentration of TC, LDL and TG in the group receiving dietary fat (G2) increased significantly ($p<0.05$) while the amount of HDL significantly decreased ($p<0.05$) in comparison to control group (Table 1). Apple supplementation to animals fed high fat diet in G3 took the values of lipid profile, specially TC and LDL, back towards normal, increasing the amount of HDL (Table 1).

DISCUSSION

In this study the effect of supplementation with Apple on the high cholesterol diet induced hyperlipidemia in male rats, were studied. Studies showed that increased serum cholesterol and LDL and decrease HDL levels of primary factors for predicting atherosclerosis and cardiovascular disease [2, 4, 5, 7]. Adding 2 % of cholesterol to diet for one month elevated blood lipids, TC, LDL and TG and decreased HDL. Gorinstein *et al.*, (1998) and Vaskonen *et al.*, (2002) showed that the amount of TC and LDL increased in hypercholesterolemic animals [7, 32], is in agreement. This factor heavily to create animal models of diet-induced hypercholesterolemia with high cholesterol and fat is used, the underlying nature of the comparison of different materials can provide.

In this study, apple reduced the amount of TC, LDL and TG and increased HDL levels. Various researchers and the effect of oral administration of this substance on lipid laboratory animals have shown regarding the effects of supplementation but a special study has been done. So that the results of this study results Aprikian *et al.*, (2001), Marounek *et al.*, (2007) and Ogino and Colleagues, (2007) in rat conforms to [13, 21, 34]. Decorde *et al.*, (2008) showed that in hamster, apple can prevent experimental atherosclerosis and they were mentioning that this effect probably due to phenolic compounds in apple [26]. Osada *et al.*, (2006) in a study on rats fed high cholesterol diets showed that apple polyphenols dose-dependently reduced the amount of cholesterol and LDL and increases the amount of HDL [30]. Nakazato *et al.*, (2006) in rats showed that diets containing apple polyphenols during the 3 weeks is capable of adipose tissue in the body weight of the animal decreases [29]. Also Lotito *et al.*, (2006) suggested that food containing flavonoids can total plasma antioxidant capacity increase [35]. Also marked the highest antioxidant effects is related polyphenols in the food [11, 13]. In addition to Apple previously mentioned materials, components as is found Procianidin have shown that this material is able to reduce blood lipids [36]. Vidal *et al.*, (2005) showed that the existing Procianidin apples inhibit ester synthesis and lipoprotein secretion is inhibited. They also reported that apple polyphenol inhibits the secretion of intestinal lipoproteins, Thus cholesterol, triglyceride and LDL decreased [36]. In human studies about the effects of apples on lipids and lipoproteins has been done. So that Abidov, *et al.*, (2006) in a controlled study, two strains uninformed, which was 4 weeks, showed that

Table 1: Effect of supplementation with apple on TC, LDL, HDL and TG (mg/dl) in serum of male rats fed with high cholesterol diet

Groups	TG	HDL	LDL	TC
G ₁	45.6±1.25	43.7±1.4	38.2±1.24	90.8±1.85
G ₂	98.7±2.1 ^a	33.2±1.44 ^a	58.3±1.85 ^a	112.5±1.91 ^a
G ₃	95.3±1.34 ^a	35.13±17 ^a	47.89±1.66 ^{ab}	102.8±1.58 ^{ab}

1) Group data are presented as mean ± SEM

2) a: P<0.05 compared with the control group and b: P<0.05 compared with Chol is in each column

3) Abbreviations: TC; total cholesterol, LDL; low-density lipoprotein, HDL; high density lipoprotein, TG; triglycerides

consumption of fruits such as apples can significantly reduce the amount of cholesterol in the human. The amount of LDL and HDL were increased and decreased, but these changes are not meaningful [37]. Has been shown that 20-25% of daily needs body polyphenols and 10-30% of the daily fiber your body needs is allocated to the apple in communities [17, 19, 22, 23]. Researchers, the most effective of apple in reducing plasma cholesterol and liver cholesterol and also believed that the antioxidant role [11, 13, 24, 31]. Fiber contained in apples, the main role in plasma cholesterol is reduced. Laboratory results have shown that about 50% of the fiber pectin found in apples. Pectin in apples has most effect on lipid metabolism [20, 24]. Apple also has other metabolites such as polyphenols that have antioxidant role and also have the effect of lipid metabolism [12, 14, 31]. Research has shown that poly galacturonic acid in pectin, the most effective plasma cholesterol decreasing is found to be [14]. Findings of researchers suggest that cholesterol and triglyceride plasma power decreasing effect by Polyphenols found in citrus fruits, soy and grape extract, polyphenol less than exist in the apple is. Results show that the highest rate of apple polyphenol is the Quercetin. Phloretin and Isorhamnetin although exist the low rate found in apple [8, 10, 15, 38]. Researchers, the effect of reducing plasma cholesterol in apples and liver cholesterol, the role of different antioxidant compounds that are linked [11, 13, 24, 31, 39, 40]. Therefore concentration decreased TC, TG and LDL by Apple in this study was not unexpected and may be this way.

CONCLUSION

In summary, this study showed that supplementation with apple along with a high cholesterol diet in rats, reduced the amount of TC, LDL and TG and increased HDL concentration. These effects can be due to antioxidant effect of compounds constituting the food was linked, probably by inhibiting lipid peroxidation and decrease production of cholesterol, LDL and triglycerides. However, the role of Apple as a supplement for the prevention of hypercholesterolemia in humans, further investigation is needed.

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