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The Effect of Artichoke Supplement on Lipid Metabolism in Rats Subjected to Experimental Acute Exercise Model

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ABSTRACT

Artichoke (*Cynara scolymus* L.), is a plennial plant which is belongs to the Asteraceae family. Caffeic acide derivatives, flavonoids, lactones, tannin and inulin has been found in leaves of artichoke. Artichoke leaf extracts have liver protective and choleretic effects. Regular physical activity is called as exercise. In this study, we aimed to investigate the effect of artichoke extract on lipid profile in experimental acute exercise model of rats. 18 male Wistar Albino rats were used in this study as animal material. Rats divided into three groups as control, acute exercise and acute exercise+artichoke. In acute exercise and acute exercise+artichoke groups; rats have been runned in 30 m/min rate on the treadmill for 30 minutes for two weeks. In artichoke+acute exercise group; 100mg/kg of artichoke extract per rat were added the rat's drinking water for two weeks. At the end of the study, changes in the lipid profile (total cholesterol, triglycerides, HDL and LDL levels) levels in rats have been determined with commercial kits. In acute exercise+artichoke group, total cholesterol and LDL levels were lower when compared to the exercise group and HDL levels were higher. With the light of the data obtained from the study, artichoke supplement was considered as beneficial on lipid profile in acute exercised rats.

Key words: Acute exercise, Artichoke, Lipid profile, Rats.

Deneysel Olarak Akut Egzersiz Yaptirilan Ratlarda Enginar Takviyesinin Lipid Metabolizmasi Üzerine Etkisi

ÖZET

Enginar (*Cynara scolymus* L.) Papatyagiller (Compositae) familyasına dahil çok yıllık bir bitkidir. Yaprağın içeriğinde kafeilkinik asit türevleri, flavonoidler, laktonlar, tanen, inulin vs bulunur. Yaprak ekstreleri, karaciğer koruyucu olan ve karaciğer-safrakesesi hastalıklarının tedavisinde kullanılan ilaçların terkibine girer. Egzersiz düzenli olarak yapılan fiziksel aktivitedir. Bu çalışmada deneysel olarak akut egzersiz yaptırılan ratlarda enginar takviyesinin lipid profili üzerine olan etkisinin araştırılması amaçlanmıştır. Bu çalışmada hayvan materyali olarak 18 adet erkek Wistar Albino cinsi rat kullanıldı. Ratlar kontrol, akut egzersiz ve akut egzersiz+ enginar olmak üzere rastgele 3 gruba ayrıldı. Akut egzersiz ve akut egzersiz + enginar grubunda ratlar iki hafta boyunca treadmillde 30 dk 30 m/min koşturuldu. Akut egzersiz + enginar grubunda ratların içme sularına iki hafta boyunca rat başına 100 mg/kg enginar ekstratı eklendi. Çalışmanın sonunda lipid profilinin (total kolesterol, trigliserid, HDL ve LDL düzeylerinin) belirlenmesi ticari kitlerle yapılmıştır. Akut egzersiz yaptırılan ratların total kolesterol düzeyleri, akut egzersiz ve enginar+egzersiz grubuna göre yüksek bulunmuştur. Ayrıca enginar verilen ratlarda serum total kolesterol akut egzersiz grubundan düşük bulunmuştur. Çalışmadan elde edilen bilgilerin doğrultusunda akut egzersiz yaptırılan ratlarda enginar ekstraktı takviyesinin lipid profilini iyi yönde değiştirdiği ortaya konulmuştur.

Anahtar kelimeler: Akut egzersiz, Enginar, Lipid profili, Rat.

INTRODUCTION

Exercise is a physical activity performed on a regular basis (George et al.1998). Objectives of exercise are to regulate oxygen dispersion and metabolic processes, to improve strength and endurance, to reduce body fat and to better muscle joint mobility (Günay 1998). Intense exercise accelerates metabolic rate, leading to a 15-20-fold increase in oxygen intake. Intracellular liquid accumulates in extracellular space as arterioles dilate. Systolic and arterial blood pressure increase during exercises (Sönmez 2002). Fat oxidation increase a 10-fold in relation to energy consumption during moderate exercise. Increase in fatty acids is due to the increase in lipolysis and decrease of re-esterification of non-esterified fatty acids to triglycerides (Turunç et al. 2008). In healthy people during exercise, intra-muscle triglyceride use increases, whereas use of free fatty acid use in plasma decreases (Özcan 2009).

Lipids, as main energy source of organism, are organic molecules which are insoluble or slightly soluble in water due to their hydrophobic structures. They exist in plasma as dissolved lipoprotein particles (lipid-protein complex) binding with specific apoproteins (Champe and Harvey 1994). Lipoproteins play a vital role in absorption of diet cholesterol, long-chain fatty acids and fat-soluble vitamins, transfer of triglycerides, cholesterol and fat-soluble vitamins from liver to peripheric tissues and cholesterol from peripheric tissues to liver (Ginsberg 1998).

Exercise training positively effects the lipid and carbohydrate metabolisms, and may lead to decrease in body weight, lipid ratio, total cholesterol and serum triglycerides (TG), low-density lipoprotein (LDL) cholesterol and an increase in antiatherogenic high-density lipoprotein (HDL) cholesterol. Decreases in total cholesterol and LDL cholesterol may stimulated by exercise (Tran and Weltman 1985). Isometric exercise trainings also have a positive effect on body fat tissue distribution, and this effect on fat tissue distribution plays a significant role on reduction in cardiovascular risk (Schwartz et al.1991).

Various functional foods or nutrients are being investigated for their effectivity in prevention and treatment of diseases (Akçay et al. 2019; Aşkar and Deveboynu 2018). Artichoke (*Cynara scolymus L.*) is a perennial plant from daisy family (*Compositae*) (Bulduk et al. 2003). Artichoke leaf (*Cynarae folium*) is registered in European Pharmacopeia. Composition of leaf consists of caffeoylquinic acid derivatives (cynarine, caffeic acid, chlorogenic acid, neochlorogenic acid, crypto chlorogenic acid), flavonoids (luteolin, rutin), sesquiterpene lactones (cynaropicrin, dehydrocynaropicrin, grosheimin, cynaratriol), tannin, inulin etc. Leaf extracts exist in liver-protectants and in medicines used in treatment of liver-gallbladder diseases. Artichoke is considered to be one of the six plants in terms of most beneficial for human health (Jain et al. 2007).

Figure 1. Artichoke Plant

Artichoke's benefits to human health are very well-known with its diuretic, bile secretion promoting, arteriosclerosis preventive effects for many years (Griggs and Jacobi 2005). Therefore, the objective of this study was to investigate effects of artichoke supplement on lipid profile of rats subjected to experimental acute exercise.

MATERIAL AND METHODS

In this study, 18 male 12 week-old Wistar Albino rats have been used. The rats have been fed with tap water and standart pellet and ad libitum in the rooms which are 12 hours light, 12 hours dark and 22 ± 2 ° C.

Green artichoke plants were provided from Mediterranean Region, City of Antalya Wholesales market. Leaves of these artichoke plants were grinded thoroughly with liquid nitrogen for homogeneity. Quantities of samples were taken from this homogenized specimen for extraction. Soxhlet extraction apparatus was facilitated for extraction of artichoke plant leaves. 500 mL ethanol was used as solvent for extraction

of this homogenized artichoke specimen. Artichoke leave extracts were obtained for this study at the end of a 4-day extraction period.

Eighteen rats were put into the adaptation with water and standart rat feed for one week. Then, these rats were divided into 3 groups and there would 6 animals per each group.

1. Control group : This group was fed with standard feed and water for the 2-week trial.

2. Acute exercise group: In this group, rats were placed on the treadmill for 10 minutes for one-week for treadmill adaptation. On the second week, rats were adapted to running on the treadmill for 25 minutes with accelerating speed. Then for 2 weeks, rat's exercise started with 10 m/min speed and 0% incline, and speed and intensity were increased gradually in 10 minutes to 30 m/min. After 30 minutes of exercise, speed and intensity were decreased in 10 minutes gradually, and the exercise was completed in 50 minutes every day. This procedure was repeated for 5 days in a week for acute exercise group (at 1000 in the morning - at 1400 in the afternoon) for 2 weeks.

3. Acute exercise + artichoke group: This group was fed with standard feed, their daily water consumption was calculated and 100 mg/kg of artichoke extract per rat was added to their daily drinking water for the 2-week trial period. In addition rats were placed on the treadmill for 10 minutes for one-week for treadmill adaptation. On the second week, rats were adapted to running on the treadmill for 25 minutes with accelerating speed. Then for 2 weeks, rat's exercise started with 10 m/min speed and 0% incline, and speed and intensity were increased gradually in 10 minutes to 30 m/min. After 30 minutes of exercise, speed and intensity were decreased in 10 minutes gradually, and the exercise was completed in 50 minutes every day. This procedure was repeated for 5 days in a week for acute exercise group (at 1000 in the morning - at 1400 in the afternoon) for 2 weeks.

At the end of 2 week period, following 12 hours of fasting blood samples were taken from the hearts of rats under general anesthesia as approved by Ethics Committee. Blood samples were taken into serum tubes for obtaining serum samples. Obtained serum samples were stored at – 80 0C until they were analyzed.

Serum triglycerides, total cholesterol, HDL levels were analyzedin Roche Modular System autoanalyzer with enzymatic colorimetric method, by using Roche Diagnostic's reagent. Serum LDL levels were calculated with Friedewald formüle (1972).

LDL= Total Cholesterol – [(HDL) + (Triglyceride/5)]

For statistical evaluation of data 'SPSS 11.0 for windows' package program was used. Statistical differences between groups were evaluated with one way ANOVA test. Results were expressed as X ± Se. $p<0.05$ and values below were considered to have statistical significance.

RESULTS

In the present study we determined the lipid profile, which includes serum triglyceride, HDL, and LDL cholesterol levels of rats in the experimental groups. And lipid profile levels of rat's experimental groups (control, acute exercise, artichoke+ exercise) were given in Table 1.

Table 1. Lipid Profile Levels of Experimental Rat's Groups

Parameters	Control Group	Acute Exercise Group	Artichoke +Acute Exercise Group
Triglyceride (mg/dL)	41.75 ± 15.4[a]	82.41 ± 18.7[b]	58.23 ± 14.2[c]
Total Cholesterol (mg/dL)	52.74 ± 12.5[a]	98.68 ± 20.1[b]	74.57 ± 25.4[c]
LDL Cholesterol (mg/dL)	47.03 ± 8.1[a]	73.18 ± 15.4[b]	54.65 ± 11.6[c]
HDL Cholesterol (mg/dl)	55.12 ± 8.6[a]	36.79 ± 7.4[b]	46.41 ± 5.8[c]

[a, b, c]: Indicates statistical significance. ($p<0.05$)

While in the study serum triglyceride levels of Artichoke+exercise group were found lower than the rats in acute exercise group. Artichoke+exercise group exhibited a significant increase in serum triglyceride levels when compared to the control group with statistical significance of $p<0.05$ (Table 1, Figure 2).

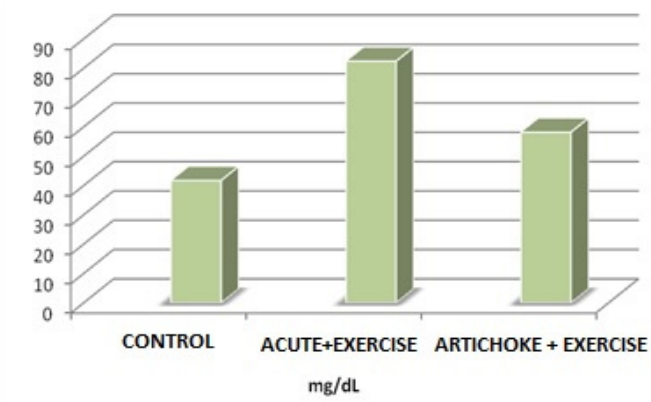

Figure 2. Serum Triglyceride Levels of Experimental Groups

In the study, total cholesterol levels of control, acute exercise and artichoke+exercise groups were determined as 52.74 mg/dL, 98.68 mg/dL, and 74.57 mg/dL respectively. Serum total cholesterol levels in artichoke+exercise group were found lower than the acute exercise group. On the other hand, serum total cholesterol levels in artichoke+exercise group were found higher than the control group with a statistical significance of $p<0.05$ (Table 1, Figure 3).

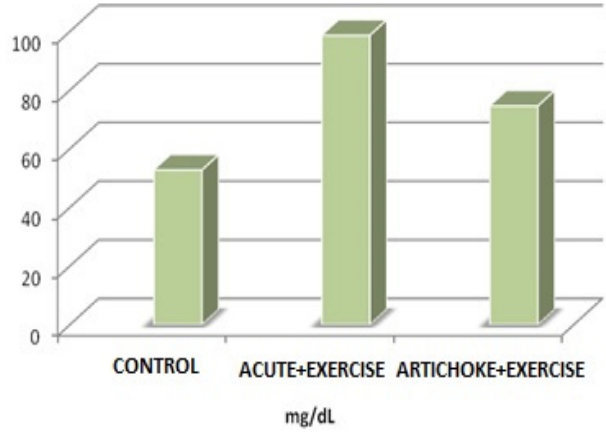

Figure 3. Serum Total Cholesterol Levels of Experimental Groups

In the study, serum LDL levels were determined in control group, acute exercise group and artichoke+exercise group as 47.03 mg/dL, 73.18 mg/dL and 54.65 mg/dL, respectively. In artichoke+exercise group there were lower LDL levels than the acute exercise group. On the other hand, LDL levels in artichoke+exercise group were found significantly ($p<0.05$) higher than the control group (Table 1, Figure 4).

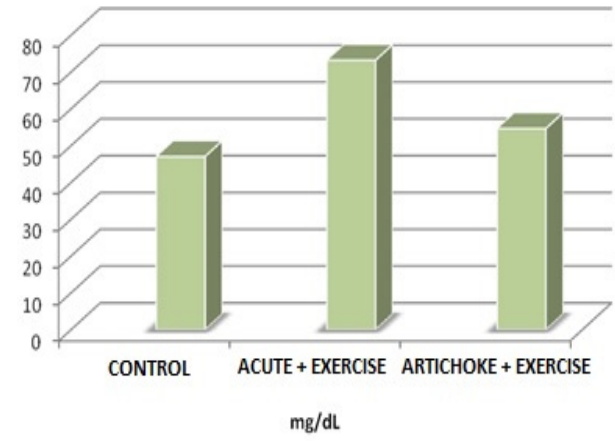

Figure 4. Serum LDL Levels of Experimental Groups

Also we determined serum HDL levels in control, acute exercise, and artichoke+exercise as 55.12 mg/dL, 36.79 mg/dL, 46.41 mg/dL, respectively. Serum HDL levels of artichoke+exercise group were found significantly higher ($p<0.001$) when compared to rats in acute exercise group (Table 1, Figure 5).

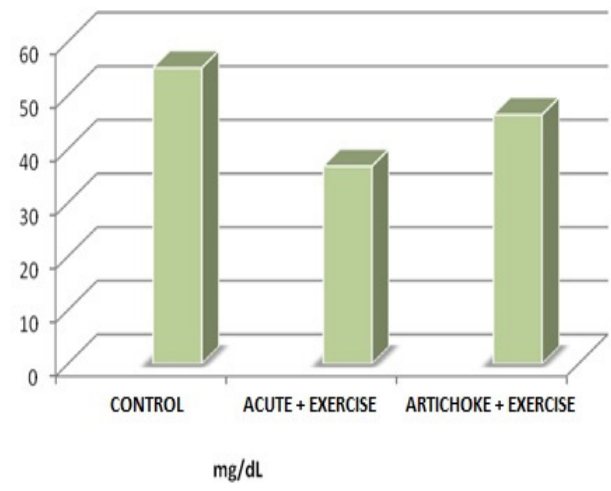

Figure 5. Serum HDL Levels of Experimental Groups

DISCUSSION AND CONCLUSION

Exercise is a regularly performed physical activity. This regular exercise positively influences lipid and lipoprotein levels, indirectly providing a positive effect on the heart. Exercise trainings cause decreases in total blood cholesterol, serum triglycerides and LDL cholesterol, whereas they promote increases HDL cholesterol (Enger et al. 1980). The aim of this study was to determine the effect of artichoke extract on

lipid profile in rats subjected to acute exercise performance.

LDL is the primary cholesterol-carrying lipoprotein in plasma. Approximately 70% of total cholesterol in plasma retain in LDL. LDL is responsible of transfer of cholesterol to extrahepatic tissues for use in membrane and steroid hormone synthesis (Stein and Myers 1994). HDL, on the other hand, is assessed as protective lipoprotein fraction against atherosclerosis. HDL is responsible of transfer of cholesterol to liver from various organs and tissues. HDL forms 90% of total plasma cholesterol (Adamu et al. 2008).

Acute exercise is an intense physical activity performed for a short period of time. A number of studies have shown that changes occur in lipoprotein fractions during acute exercise, in addition to changes in size and compounds. Due to stress formation during acute exercise, total cholesterol, triglyceride and LDL levels increase; whereas there is a decrease in the HDL levels, that is called as good cholesterol. Enger et. al. (1980) have reported that the increase in plasma cholesterol in acute exercised rats may be a result of changes in lipid metabolism in tissues.

It has been determined that there are changes in the levels of triglycerides, total cholesterol, HDL, LDL and VLDL cholesterol in exercise (Enger et al. 1980, Günay, 1998; Özcan, 2009). In the study, serum triglyceride, total cholesterol and LDL levels were significantly higher in acute exercise group than the control and artichoke+ acute exercise groups at the end of 2 week trial period. Whereas, serum HDL levels are significantly lower in acute exercise group when compared with control and artichoke+acute exercise groups. The increase in triglyceride levels in acute exercise group following exercise may be a result of increase in disruption of TG under the influence of lipoprotein lipase (LPL).

Moreover, serum triglyceride, total cholesterol and LDL levels of rats having artichoke supplement have been found lower than the acute exercise group. Similar to our results, in a study of 143 patients with high cholesterol problem, changes in cholesterol levels following a 6-week of artichoke supplement (daily intake of 6 g), authors have been found 18.5% decrease in total cholesterol levels, 23% decrease in LDL cholesterol levels, increase in HDL cholesterol levels, and a 20% decrease in LDL/HDL ratio (Sady et al. 1986).

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