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RESEARCH ARTICLE

# Effects of ginseng on antioxidant enzymes in rats fed cholesterol rich diet

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# Yüksek kolesterollü diyetle beslenen ratlarda ginsengin antioksidan enzimler üzerine etkileri

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## Öz

**Amaç:** Bu çalışmada yüksek kolesterollü diyetle beslenen ratlarda ginsengin antioksidan enzimler üzerine etkilerinin belirlenmesi amaçlanmıştır.

**Gereç ve Yöntem:** Çalışmada kullanılan hayvanlar kontrol, kolesterol ve kolesterol + ginseng grubu olarak üç eşit gruba ayrıldı. Kontrol grubu 40 gün süre ile standart rat yemi ile ad libitum olarak beslendi. Kolesterol grubu %5 kolesterol içeren yemle beslenirken, kolesterol + ginseng grubu ise %5 kolesterol ve 1 g/kg panax ginseng kök tozu içeren aynı yemle beslendi. Çalışmanın 40. gününde bütün gruplardaki hayvanlardan kan örnekleri alındı. Alınan kanların plazmalarında tiyobarbitürik asit reaktif ürünleri (TBARS), süperoksit dismutaz (SOD), glutatyon (GSH), glutatyon peroksidaz (GPx) ve katalaz (CAT) düzeyleri belirlendi.

**Bulgular:** Çalışmada kolesterollü diyetle beslenen gruptaki hayvanlarda belirlenen GSH ve SOD düzeylerinin kontrol grubu değerleri ile karşılaştırıldığında anlamlı olarak azaldığı gözlenirken ($P<0.05$), aynı parametrelerin kolesterol + ginseng grubunda kolesterol ve kontrol grupları değerlerinden farksız oldukları belirlendi. Çalışmada TBARS, GPx ve CAT düzeyleri bakımından gruplar arası herhangi önemli bir farklılığın meydana gelmediği görüldü.

**Öneri:** Elde edilen sonuçlara dayanarak hiperkolesterolemiye bağlı gelişen oksidatif stres riski üzerine panax ginsengin yararlı etkilerinin olabileceği kanaatine varıldı.

**Anahtar kelimeler:** Kolesterol, ginseng, oksidatif stres

## Abstract

**Aim:** In this study, it was aimed to investigate the effects of ginseng on antioxidant enzymes in rats fed cholesterol rich diet.

**Materials and Methods:** Rats were equally divided into three groups: control group, cholesterol group and cholesterol + ginseng group. The control group had fed as ad libitum with a standard rat diet for 40 days. The cholesterol and cholesterol + ginseng groups had ad libitum access to the same diet containing 5% cholesterol powder and 5% cholesterol + 1 g/kg panax ginseng root powder, respectively, for 40 days. On the 40th day of the study, blood samples were taken from all animals in each group. In plasma samples, thiobarbituric acid reactive substances (TBARS), superoxide dismutase (SOD), glutathione (GSH), glutathione peroxidase (GPx) and catalase (CAT) levels were determined.

**Results:** GSH and SOD levels significantly decreased with feeding high cholesterol diet compared to control group ($P<0.05$), while these parameters in cholesterol + ginseng group were not different from both cholesterol and control group. There was no difference among the groups in respect of TBARS, GPx and CAT levels.

**Conclusion:** These results indicate that panax ginseng might be beneficial to reduce risk of hypercholesterolemia-induced oxidative stress.

**Keywords:** Cholesterol, ginseng, oxidative stress

## Introduction

Hypercholesterolemia is an important risk factor in the development of atherosclerosis and coronary heart disease (CHD). Cardiovascular diseases are the main cause of mortality in the world (Braunwald 1997, Khoo et al 2003). Lipid peroxidation depend on free radicals has been interfere with the pathogenesis of atherosclerosis, and reactive oxygen species (ROS) are thought to be the trigger of lipid peroxidation (Penn and Chisolm 1994). Recent reports suggested that some plants can also diminish the production of ROS in addition to their lipid-lowering ability and enhance the resistance of plasma lipoprotein to oxidation that may contribute to preventing atherosclerotic disease (Kim et al 2003, Rosenson 2004, Ou et al 2006). Traditional herbal medicine has become progressively common alternative for the treatment of assorted physiological disorders in the worldwide (Cheng 2000). Panax ginseng, as most popular herb, has been showed to have lipid-reducing properties and antioxidant activities (Cicero et al 2003, Kim and Park 2003, Yao et al 2008).

The some studies showed a strict relation between ginseng consumption and high levels of activated oxygen species in several pathological states or normal processes such as exercise (Yuan and Kitts 1996). The balance of oxidative status is ensured by the activity of both non-enzymatic antioxidant compounds (e.g. tocopherols, b-carotene, glutathione) and antioxidant tissue enzymes (e.g. superoxide dismutase (SOD), catalase (CAT), glutathione peroxidase (GPx). All of them together prevent reactive oxygen species formation, or work to save from the damage caused to cells by various sources of free radicals (Yuan and Kitts 1996). It has been shown that ginseng constituents supported antioxidant mechanisms and reduced oxidative stress in several tissues of rats (Deng and Zhang 1991, Rimar et al 1996, Voces et al 1999, Kitts and Hu 2000). In this study, it was aimed to investigate the effects of ginseng on antioxidant enzymes in rats fed cholesterol rich diet.

## Materials and Methods

In this study, 24 healthy, adult male Wistar Albino rats were equally divided into three groups: Control group (K), cholesterol group (C) and cholesterol + ginseng group (CG). The K group had fed as ad libitum with a standard rat diet (Purina®, Optima Besin Maddeleri San. ve Tic. A.Ş., Balıkesir, Turkey) for 40 days. The C and CG groups had ad libitum access to the same diet containing 5% cholesterol powder (Sigma-Aldrich, Steinheim, Germany) and 5% cholesterol + 1 g/kg panax ginseng root powder (General Nutrition Products Inc., 1050 Woodruff Road Greenville, SC, USA), respectively, for 40 days. On the 40th day of the study, blood samples were taken from all animals in each group. In plasma samples, thiobarbituric acid reactive substances (TBARS), superoxide dismutase (SOD), glutathione (GSH), glutathione peroxidase (GPx) and catalase (CAT) levels were determined using a commercial sandwich enzyme-linked immunosorbent assay (Bio-Tek Instruments, Inc). Ethical Committee of SU Veterinary Faculty (Report No: 2014/39) approved the study protocol.

The data were analyzed using one-way ANOVA (SPSS 17). Differences among the groups were determined by Duncan's multiple range test. Differences were considered significant at $P<0.05$.

## Results

In this study, TBARS, GSH, SOD, GPx and CAT levels are presented in Table 1. GSH and SOD levels significantly decreased in C group compared to K group ($p<0.05$, Table 1), while these parameters in CG group were not different from both K and C groups. There was no difference among the groups in respect of TBARS, GPx and CAT levels.

## Discussion

In this study, the effect of panax ginseng root powder on antioxidant enzyme activities were investigated in rats fed with high cholesterol diet. The rats consuming high cholesterol diet (5%) had lower GSH, SOD, GPx and CAT activities compared to animals fed standard diet, but the changes in GSH and SOD levels were statistically significant ($P<0.05$, Table 1). Hypercholesterolemia is known to induce oxidative stress and lipid peroxidation (Lee et al 2013). GSH plays important role against toxicity and participate in the remove reactive metabolites by decreasing hydroperoxides in the existence

Table 1. The effects of ginseng on TBARS, GSH, SOD, GPx and CAT levels in rats fed cholesterol rich diet (Mean±SE).

| Group (n=8) | TBARS µM | GSH µM | SOD U/mL | GPx nmoL/min/mL | CAT nmoL/min/mL |
|---|---|---|---|---|---|
| K | 2.75±0.27 | 31.25±3.71$^{a}$ | 18.88±1.64$^{a}$ | 35.25±3.09 | 52.38±5.88 |
| C | 3.43±0.41 | 21.13±2.62$^{b}$ | 12.75±1.64$^{b}$ | 31.13±3.21 | 44.25±5.12 |
| CG | 3.06±0.33 | 27.25±1.80$^{ab}$ | 16.63±2.20$^{ab}$ | 33.75±5.55 | 46.88±6.44 |

K: Control group, C: Cholesterol group, CG: Cholesterol + ginseng group, TBARS: Thiobarbituric acid reactive substances, GSH: Glutathione, SOD: Superoxide dismutase, GPx: Glutathione peroxidase, CAT: Catalase. $^{a, b, c:}$ Different letters in the same column are statistically significant ($P<0.05$).

of GPx (Nicotera and Orrenius 1986, Marinho et al 1997, Lin and Yang 2007). CAT, SOD and GPx are formed to protect cell membranes and intracellular materials from reactive oxygen species, including free radicals. In the early stage of free radical generation, SOD plays important role in the body, converting superoxide into O2 and H2O2 (Lee et al 2013). The decreases in SOD and GSH levels showed that hypercholesterolemia caused oxidative stress in rats fed high cholesterol diet. The findings are consistent with some previous studies (Yao et al 2008, Xia et al 2011, Lee et al 2013).

Ginseng, particularly root of panax ginseng, has been used as a medicinal plant for a long time (Park et al 2001). Thus, we evaluated the effect of panax ginseng on lipid peroxidation and antioxidant system of liver in cholesterol-fed rats. Results showed that rats fed with ginseng containing diet had reduced TBARS level and increased GSH, SOD, GPx and CAT levels (Table 1). The changes were not significantly different from cholesterol group, but the enzyme levels tended to reach control group level (Table 1). There is an association between ginseng intake and activated oxygen species in various processes, this association demonstrated the importance of antioxidant mechanisms which function to maintain oxidative status (Yuan and Kitts 1996, Kitts and Hu 2000). Lee et al (2013) reported that white ginseng alleviated the negative effects of hypercholesterolemia on antioxidant enzyme activities. Yao et al (2008) noted that the panax ginseng addition to high cholesterol diet in rats caused higher GSH and lower TBARS levels compared to cholesterol diet. In the other study, it has been reported that panax notoginseng significantly reduced the elevation hepatic MDA level and increased SOD and GPx activities induced by the high-fat diet (Xia et al 2011). It has been suggested that ginseng ingredients supported directly antioxidant defense mechanisms of cells. Prolonged treatment with ginseng extract to rats noted that decreased oxidative stress in certain tissues by reducing specific end-products of tissue peroxidation reactions (Deng and Zhang 1991, Rimar et al 1996, Voces et al 1999, Kitts and Hu 2000).

## Conclusion

In summary, dietary supplementation of panax ginseng root powder to the hypercholesterolemic diet improved antioxidant status and may also play important role in protection against lipid peroxidation. Further studies are needed to elucidate the mechanism of ginseng underlying protective action against hepatic lipid peroxidation and oxidative stress induced hypercholesterolemia.

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