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Araştırma Makalesi/Research Article

Antioxidant Effects of Curcumin on the Blood Tissue in Rats

Kurkuminin Sıçanların Kan Dokusu Üzerinde Antioksidan Etkileri

Şevkinaz KONAK[1]*, Emine Hilal ŞENER[1]
[1] Burdur Mehmet Akif Ersoy University, Faculty of Health Sciences, Department of Nursing, Burdur, Turkey

Abstract: Curcumin is a pigment found in Indian saffron spices, also known as turmeric. The aim of this study is to investigate the antioxidant effect of curcumin, a phytochemical, on the blood tissue of rats. In the study, 24 Wistar rats were 8 weeks old, randomly divided into 2 groups which were the control group and the experimental group was fed with curcumin supplement. Curcumin supplemented group was fed at 300mg/kg/day curcumin dissolved in corn oil by oral gavage for 12 days. 24 hours after the last feeding, TAC (Total Antioxidant Capacity) and TOC (Total Oxidant Capacity) were analyzed in blood samples. When the TAC and TOC levels of curcumin-supplemented feeding group were examined, the level was higher than the control group ($P < 0.05$). Results of the study show that curcumin strengthens the antioxidant defense system.

Keywords: Curcumin, functional food, blood tissue, antioxidant.

Öz: Kurkumin, zerdeçal olarak da bilinen Hint safran baharatlarında bulunan bir pigmenttir. Bu çalışmanın amacı kurkuminin sıçanların kan dokusu üzerinde antioksidan etkilerini araştırmaktır. Çalışmada 8 haftalık 24 Wistar sıçan, kontrol grubu ve kurkumin takviyeli beslenen uygulama grubu olmak üzere rastgele 2 gruba ayrılmıştır. Kurkumin grubuna 12 gün boyunca günde 300 mg/kg dozunda kurkumin, mısır yağı içerisinde çözülerek oral gavaj yoluyla verilmiştir. Son beslenme saatinden 24 saat sonra alınan kan örneklerinde TAS (Total Antioksidan Seviyesi) ve TOS (Total Oksidan Seviyesi) seviyeleri analiz edilmiştir. Kurkumin takviyeli beslenen grupta TAS ve TOS seviyesi incelendiğinde seviyesinin kontrol grubuna göre istatiksel olarak daha yüksek olduğu bulunmuştur ($P<0,05$). Çalışmadan elde edilen bulgular kurkuminin antioksidan savunma sistemini güçlendirdiğini göstermektedir.

Anahtar Kelimeler: Kurkumin, kan dokusu, antioksidan.

*Corresponding author : Şevkinaz KONAK e-mail : skonak@mehmetakif.edu.tr
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Introduction

Curcuma longa L. (Curcumin), belonging to the family *Zingiberaceae*, is a multi-year herbaceous plant with yellow flower and is widely found in India and China. Turmeric, derived from the roots of this plant, has been used in India for centuries as a spice, medical drug and cosmetic product. This plant, commonly used as a coloring agent in foods and contains tetrahydrocurcumin which is odorless and heat resistant antioxidant compound (Aggarwal et al., 2007). Curcumin is known has lots of pharmacological properties include anticancer, antiinflamatory, antioxidant and antiapoptotic effects (Kunnumakkara et al., 2008, Lin et al., 2011).

Curcumin is not a toxic substance and has limited biovailability (Hatchera et al., 2008). Three grams of turmeric contains approximately 30-90 mg curcumin which is the active ingredient of turmeric. Turmeric, which has been used for centuries as a cure in different parts of the world, is commonly used to increase the body's general energy level, to relieve gastrointestinal gas, to get

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rid of tapeworms, to stimulate digestion, to regulate menstruation cycle, to dissolve gallstone and to eliminate arthritis. In addition, it has been reported that due to its antioxidant properties, it prevents damage caused by exposure to harmful agents such as alcohol, drugs, radiation and heavy metals (Phillips et al., 2013). Especially, it is a plant used for the preservation and sweetening of foodstuffs (Aggarwal et al., 2007).

The human body's most important weapon to remove the oxidative stress that can be created by free radicals is antioxidants. Antioxidants are substances that can clear free radicals and prevent cell damage. Antioxidants present in the human body are either produced naturally by the body or taken from externally. Both endogenous and exogenous antioxidants act as free radical scavengers. Therefore, it increases the effestiveness of the defense system and reduces the risk of illness (Sen et al. 2010; Shinde et al., 2012). The role of antioxidants is to passivate the excess of free radicals, protect the cells against the toxic effects of free radicals and contribute to the preventation of diseases (Dündar and Aslan 1999; Pham-Huy 2008; Şener and Yeğen 2009). Use of curcumin, a strong antioxidant, in foods and medicine is common (Kuhar et al., 2007).

Because of this quality, it is expressed that curcumin reduce oxidative stres and tissue damage in kidney, heart, brain tissue and liver ischemic damage. There is qualitative antioxidant activity comparable to Vitamin C and E (Thiyagarajan and Sharma, 2004). This activity is demostrated by avoiding the conversion of xanthine dehydrogenase (XD) to xanthine oxidase (XO), inhibiting the formation of lipid peroxidation and accumulating free oxygen radicals present in the ischemic environment (Miquel et al., 2002). Curcumin increases the activity of enzymes which are catalase, superoxide dismutase and glutathione peroxidase, thereby reduce the peroxidation of lipids in the cell membrane. The phenoxyl radical is formed by the phenolic and methoxy groups of the structure reacting with free radicals (Wright, 2002). In addition, the primary metabolite tetrahydrocurcumin has an antioxidant effect by destroying the C-C bond between the two carbonyl groups in the active methylene carbon. With this antioxidant effects, this inhibits the formation of ROS directly or affects the inhibition of the conversion of XD to XO by indirectly. However, the effect of curcumin on other hydroxyl radicals or peroxynitrite has not been elucidated yet (Manikandan et al., 2004). Chronic inflammation and cytokines induce nitric oxide (NO) synthesis leading to the formation of peroxynitrite and nitrite, which cause DNA damage and cancer. Many studies have shown that curcumin inhibits NO synthesis (Antunes et al., 2001, Doria et al., 2012). The phenoxyl radical is formed when phenolic and methoxy groups in the structure react with free radicals. In a study, it was determined that curcumin was an excellent H^+ ion donor and that the H^+ ion donated more than the methyl group. It is identified that the given H^+ ion origins from phenol group. Thus, it has been demonstrated that curcumin works bidirectionally and it is a potent antioxidant compound (Dkhar and Sharma, 2010). Also used for preservation and sweeting of foodstuff, this plant is used as a sauce in meals.

Curcumin is a food which is used for centuries without any side effects (Anand et al., 2007). Several studies have shown that curcumin inhibits the growth of different types of cancer cells. It also helps to depress hard inflammatio such as bursitis, arthritis and back pain (Kuhar et al., 2007). This plant which has a great prescription in Indian medicine, it has been reported to be used in the treatment of colds, coughs, liver disorders, rheumatism, sinusitis, anorexia and skin diseases (Ammon et al., 1992; Miquel et al., 2002; Auddy et al., 2003). The aim of this study is to investigate the antioxidant effect of curcumin, a phytochemical, on the blood tissue of rats.

Material and Methods

Research material was formed by 24 Wistar albino 8 weeks old rat (with no gender priority) were selected from Burdur Mehmet Akif Ersoy

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University Animal Experiments Production and Experimental Research Laboratory. Approval from the Animal Experiments Local Ethics Committee of Burdur Mehmet Akif Ersoy University was obtained prior to the commencement of the study (No:278/01.03.2017). Rats used in the study were divided into 2 groups, the control group and the experimental group. First group is control group and rats' live weights were taken. During the study, food (corn oil) and water were given as *ad libitum* without any interuption of feeding or any limitation which caused the stress. Second group is experimental group, and rats' live weights were taken. Rats (n=12) in this group, were given 300 mg/kg/daily dissolving curcumin (C1386; Sigma Chemical, St. Louis, MO) in corn oil by oral gavage for 12 days. Their food and water were given as *ad libitum* without any nutrition interruption or any limitation which caused the stress. Rats were weighed daily before curcumin or carrier supplement for 12 days reinforcement period. 24 hours after the last curcumin or carrier were given, abdominal cavities of rats were opened under ether anesthesia and blood samples were taken from vena cava caudalis. Blood samples of both groups were prepared and TAC and TOC (Paraoxonase kit - Rel Assay - Turkey) parameters were studied. Oxidative stress indices were determined by measuring total oxidant level (TOC) and total antioxidant level (TAC) from the blood taken from the experimental and control groups with a spectrophotometer (Perkin Elmer UV/Vis spectrophotometer model lambda 20) at Burdur Mehmet Akif Ersoy University Scientific and Technological Application and Research Center.

Total Antioxidant Capacity (TAC) Assay: TAC levels were measured using commercial kits. Findings were expressed as mmol Trolox equvalan/L (Aslan et al., 2014).

Total Oxidant Capacity (TOC) Assay: TOC levels were measured using commercial kits. Findings were expressed as mmol H_2O_2 equvalan/L (Aslan et al., 2014).

Statistical Analyzes: The results obtained were given as mean ± standard deviation. As a nonparametric test, Kruskal-Wallis variance analysis test was applied. Mann Whitney-U test was used to compare statistically different parameters. Calculations were made using the Windows-compatible SPSS 15.0 statistical program.

Results

Total Antioxidant Capacity (TAC): When the statistical significance between total antioxidant capacity (TAC) values measured in the study were evaluated; the increase in the experimental group in comparison with control group was statistically significant ($p<0.05$) (Table 1, Figure 1).

Total Oxidant Capacity (TOC): When the statistical significance between total oxidant capacity (TOC) were evaluated, it was determined that the increase in the experimental group was statistically significant compared to the control group ($p<0.05$) (Table 2, Figure 2).

Table 1. TAC values of the groups

Groups	N	TAC (mmol/g)
Control	**12**	1.22±0.06
Experimental	**12**	1.32±0.13

p<0,05

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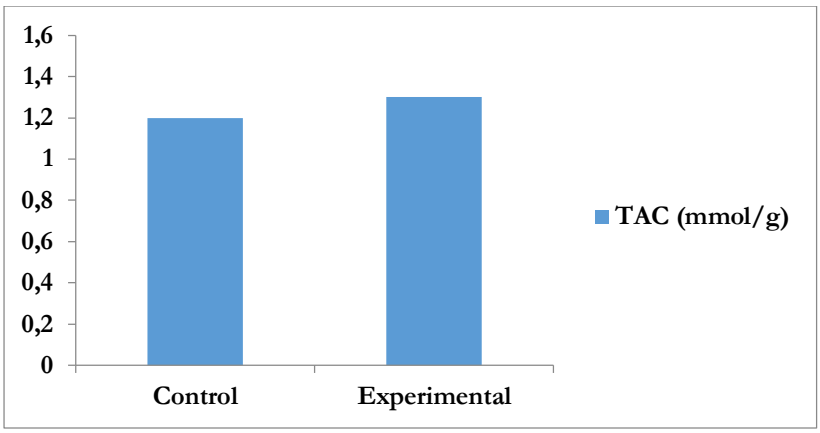

Figure 1. TAC levels (results are given as X ± SD), p<0.05

Table 2. TOC values of the groups

Groups	N	TOC (mmol/g)
Control	**12**	3.08±0.47
Experimental	**12**	3.52±0.37

p<0,05

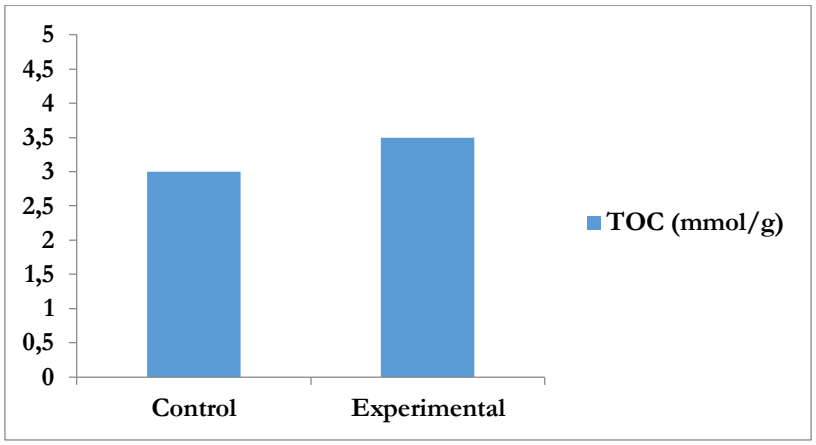

Figure 2. TOC levels (results are given as X ± SD), p<0.05.

Discussion

As a result of the study, it was determined that TAC and TOC level increased significantly in curcumin supplement group compared to the control group (P<0.05) (Table 1, Table 2). In the direction of this result, it has been determined that curcumin strengthens the antioxidant defense

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system. In the literature, there are studies which are supporting the antioxidant properties of turmeric is origines curcumin as a phenolic component. In the literature, there are studies support that turmeric's antioxidant properties originate from curcumin which is a phenolic component. Because of this reason, curcumin is an antioxidant that can be safely used in food industry (Ak and Gulcin, 2008).

In study by Jayaprakasha et al. (2005), it was found that turmeric increases the period of storage by inhibiting the formation of peroxides in food, the components isolated from turmeric (*Curcuma longa L.)* show a strong antioxidant effect and important for lipid oxidation even more effective than vitamin E. In another study, 400 ppm of turmeric extract was added to chicken meat and the antioxidant properties were investigated. When the results of the study were compared with the control group, it was stated that the turmeric extract was significantly effective and turmeric's antioxidant properties are originated from the phenolic components (Sharma, 1976). Similarly, in another study, antioxidant properties of curcuminoids were investigated and the antioxidant capacity of these extracts was determined to be equivalent to ascorbic acid. It has been determined that the antioxidant activity of curcumin is higher than 100 ppm BHT (Khanna, 1999).

In studies, it has been reported that curcumin has a protective role on the heart due to the antioxidant effect and that 300 mg / kg dose shows antioxidant effects (Thiyagarajan, 2004; Nazam et al., 2007; Zhao et al. 2008; Naik et al., 2011; Diyan et al., 2012). Belviranlı et al. (2012) found that curcumin protects the cardiac tissue of aged female rats against oxidative damage and strengths the antioxidant defense system. In another study, curcumin showed strong antioxidant and antiinflammatory effects againts tissue damage that may occur in liver and kidney because of experimental sepsis model in rats (Gülay et al., 2013). In a study by Kavaklı et al. (2011), curcumin effectively protected the spinal cord tissues against oxidative damage.

Curcumin has sweeping effects to many free radicals mainly hydrogen peroxide and also superoxide anions, nitrogen dioxide radicals, hydroxyl radicals. Moreover it reduce oxidative stress by increasing levels of antioxidant enzymes such as superoxide dismutase, catalase, glutathione peroxidase. Many studies discovered that curcumin inhibits lipid peroxidation, lipid degradation and oxidative DNA damage in vitro and in vivo (Sharma, 2005; Maheshwari, 2006; Goel, 2008; Pari, 2008). The effects of curcuminoids on brain tissue and liver microsomes of rats were investigated and it was found that all of the curcuminoids inhibited lipid peroxidation; the methoxy group attached to the phenolic ring and the diketone structured curcumin were found highly prominent in antioxidant effect (Sreejayan and Rao, 1994). In Thiyagarajan and Sharma's study (2004), curcumin reduced tissue damage in a cerebral ischemia reperfusion injury by inhibit lipid peroxidation, reduced antioxidant defense enzymes and decreased free radical formation.

Curcumin has a great antioxidant effect comparable to the known strong antioxidant compounds. This situation makes it potential factor in the treatment of many diseases (Miquel et al., 2002; Sharma, 2005; Maheshwari, 2006; Goel, 2008; Pari, 2008). In conclusion, findings from this study show that curcumin supplementation for 12 days protects rats against oxidative damage in blood tissue and strengthens the antioxidant defense system.

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