Kafkas Univ Vet Fak Derg
22 (6): 929-936, 2016
DOI: 10.9775/kvfd.2016.15666

Kafkas Universitesi Veteriner Fakultesi Dergisi
Journal Home-Page: http://vetdergi.kafkas.edu.tr
Online Submission: http://vetdergikafkas.org

Research Article

Protective Effect of Dandelion *(Taraxacum officinale)* Extract Against Gentamicin-Induced Reproductive Damage in Male Rats [1] [2]

Ali Doğan ÖMÜR [1] Fatih Mehmet KANDEMİR [2] Betül APAYDIN YILDIRIM [2]
Orhan AKMAN [1] Esra AKTAŞ ŞENOCAK [2] Eyup ELDUTAR [2] Emrah Hicazi AKSU [1]

[1] *This project was funded by the Commission for Atatürk University Scientific Research Projects (Project no: 2013/251)*
[2] *This study has previously been presented partially in II International VETistanbul Group Congress-Saint Petersburg, Russia, 7-9 April 2015*

[1] Atatürk University, Veterinary Faculty, Department of Reproduction and Artificial Insemination, TR-25240 Erzurum - TURKEY
[2] Atatürk University, Veterinary Faculty, Department of Biochemistry, TR-25240 Erzurum - TURKEY

Article Code: KVFD-2016-15666 Received: 01.03.2016 Accepted: 27.04.2016 Published Online: 28.04.2016

Abstract

The aim of this study was to investigate the effect of *Taraxacum officinale* extract (TOE) on gentamicin-induced reproductive damage in male rats. Totally, 24 male Sprague Dawley rats were divided into four groups: Group I (n=6); referred as control, physiological saline was intraperitoneally (IP) administered. Group II (n=6); referred as gentamicin (G), 80 mg/kg gentamicin sulphate (GS) was injected IP. Group III (n=6); referred as G + TOE150, 80 mg/kg GS and 150 mg/kg TOE was given IP. Group IV (n=6); referred as G+TOE200 (n=6), 80 mg/kg GS and 200 mg/kg TOE was administered IP. The treatment continued for consecutive 8 days. The cauda epididymal semen samples and testes tissues were collected. Routine semen examinations were performed and oxidative stress levels of testicular tissues were assayed. Reproductive organ weights [total testes weight (TTW) and total cauda epididymal weights (TCEW)] were recorded. GS administration significantly decreased sperm motility ($P<0.01$), glutathione peroxidase (GPx) activity ($P<0.001$) and glutathione (GSH) level ($P<0.05$), and it significantly increased tissue malondialdehyde (MDA) level ($P<0.01$) in comparison with the control group. However, a statistical increase in sperm motility of GT150 ($P<0.01$) group and in GPx activities of both GT150 and GT200 ($P<0.01$) groups as well as a statistical decrease in MDA levels of GT150 and GT200 ($P<0.001$) groups were determined when compared with the G group. In conclusion, short-term administration of GS causes lipid peroxidative damages in testes as well as decreases in sperm motility. However, TOE has a moderate ameliorative effect on sperm motility reductions, but marked improvement effect on lipid peroxidative testicular damages induced by GS.

Keywords: *Taraxacum officinale, Gentamicin, Reproduction, Rat, Oxidative stress*

Erkek Ratlarda Gentamisinin İndüklediği Üreme Hasarına Karşı Karahindiba *(Taraxatum officinale)* Ekstresinin Koruyucu Etkisi

Özet

Bu çalışmanın amacı, gentamisinin erkek ratlarda oluşturduğu reprodüktif hasar üzerine karahindiba ekstresinin (*Taraxacum officinale* extract, TOE) etkilerini araştırmaktı. Toplam 24 adet erkek Sprague Dawley rat dört gruba bölündü: Grup I (n= 6) kontrol grubu olarak adlandırıldı ve hayvanlara intraperitonal yolla fizyolojik tuzlu su uygulandı. Grup II (n=6) gentamisin (G) olarak adlandırıldı ve hayvanlara 80 mg/kg gentamisin sülfat (GS) intraperitonal (IP) yolla enjekte edildi. Grup III (n=6) G + TOE150 olarak adlandırıldı, 80 mg/kg GS ve 150 mg/kg TOE hayvanlara IP yolla enjekte edildi. Grup IV G+TOE200 (n=6) olarak adlandırıldı ve 80 mg/kg GS ile 200 mg/kg TOE hayvanlara IP yolla enjekte edildi. Tedavi ardışık 8 gün boyunca uygulandı. Kauda epididimal sperm örnekleri ve testis dokuları toplandı. Rutin sperma muayeneleri yapıldı ve testis dokularının oksidatif stres düzeyleri ölçüldü. Reprodüktif organ ağırlıkları [toplam testis ağırlığı (TTW) ve toplam kauda epididimis ağırlıkları (TCEW)] kaydedildi. GS uygulaması önemli ölçüde sperm motilitesini ($P<0.01$), glutatyon peroksidaz (GPx) aktivitesini ($P<0.001$) ve glutatyon (GSH) düzeyini ($P<0.05$) düşürdü ve önemli derecede doku malondialdehit (MDA) düzeyini ($P<0.01$) kontrol grubuna kıyasla artırdı. Ancak, istatistiksel olarak G grubuna kıyasla GT150 grubunun sperm motilitesinde ($P<0.01$) ve GT150, GT200 gruplarının GPx aktivitelerinde ($P<0.01$) bir artış olduğu gibi, GT150 ve GT200 gruplarının MDA düzeylerinde ($P<0.001$) bir düşüş belirlendi. Sonuç olarak, kısa süreli GS uygulaması testislerde lipit peroksidasyona sebep olduğu gibi sperm motilitesinde de azalmaya sebep olmuştur. Bununla birlikte, TOE sperm motilitesinin düşüşünde makul oranda iyileştirici etkiye sahiptir, fakat GS indüklü lipid peroksidatif testiküler hasar üzerine belirgin etkisi vardır.

Anahtar sözcükler: *Karahindiba, Gentamisin, Reprodüksiyon, Rat, Oksidatif stres*

İletişim (Correspondence)
+90 442 231 7125
alidogan@atauni.edu.tr

INTRODUCTION

Taraxacum officinale, known as dandelion or lion tooth, is a plant belonging to Asteraceae (composite) [1]. It has been used as protective and curative for many disease and preservative for nutrients [2]. It has been reported that an improvement was observed in the endogenous antioxidant profile by applying roots and leaves of *Taraxacum officinale* to the rats [3-5]. *Taraxacum officinale* extract (TOE) is comprised of beta carotene, provitamin A, xanthophyll, chlorophyll, vitamins C and D, B-complex vitamins, choline, iron, silicon, magnesium, sodium, potassium, zinc, manganese, copper and phosphorus that almost all of these items are known as strong free radical scavengers. It has been found that these structures are strong free radical scavenger and to inhibit lipid peroxidation. The presence of fatty acids, enzymes, vitamins and minerals in various ratios and amounts are demonstrated by the phytochemical studies made upon the *Taraxacum officinale* [2,6]. *Taraxacum officinale* extract particularly ethyl acetate fraction has bioactive phytochemicals effects which can eliminate the reactive oxygen species in vitro medium and it protects DNA against damages of reactive oxygen species (ROS) [7].

Gentamicin is an aminoglycoside antibiotic and effective against various microorganisms [8]. It has been reported that gentamicin adversely affects phosphatase activity and sperm count in male rats [9]. In addition, it was emphasized that gentamicin induced the ascorbic acid mobilization from testis and by this way decrease of the reproductive potential [10].

Gentamycin inhibits cell division of gem cells and protein synthesis in the testis, damages the testicular tissue and reduces sperm count, sperm motility, and sperm viability by increasing the free radical formation and lipid peroxidation and by decreasing antioxidant enzyme levels [11,12]. Oxidative stress is an important factor which influences fertility potential of spermatozoa by lipid peroxidation which may result in sperm dysfunction [13]. Reactive oxygen species (ROS) has pathological roles in male infertility [14].

There was no data in literature about protective effect of dandelion *(Taraxacum officinale)* extract against gentamicin-induced reproductive damage in male rats.

The present study aimed to evaluate the protective effect of *Taraxacum officinale* extract against gentamicin-induced reproductive damage in male rats.

MATERIAL and METHODS

The approval of Atatürk University Animal Experimentations Local Ethics Committee (Approval number: 2013/132) was taken before starting the study.

Plant Material

T. officinale L. samples were collected in September 2013 from Erzurum (Turkey) and identified by Saban KORDALI (Atatürk University, Faculty of Agriculture, Department of Plant Protection, Erzurum). A voucher specimen has been deposited in the Herbarium of Ataturk University, Erzurum (Turkey).

Preparation of the Samples

Plant materials were dried under shade and powdered coarsely before extraction. The dried *T. officinale* L samples were powdered in a blender and then 100 g of sample was extracted individually with 500 mL ethanol at room temperature. The extract was filtered and evaporated to dryness in a vacuum at 40°C with a rotary evaporator after 48 h. Filtration, the organic solvents were evaporated under reduced pressure and temperature. The dried extracts were stored at 4°C until used. The extract was dissolved in 0.5% aqueous carboxymethylcellulose (CMC) suspension in distilled water prior to intraperitoneally administration to animals by using needle eight days.

Animals and Experimental Procedure

In the study, 24 male Sprague Dawley rats aged eight weeks old and weighted 250-300 gr, were used. The animals were obtained from Atatürk University Experimental Research Centre and housed in standard laboratory conditions. Commercial pellet chow and fresh drinking water were available *ad libitum*. Rats were divided into four groups. I. group (n= 6) referred as control group and physiological saline was intraperitoneally (IP) administered. II. group (n=6) referred as Gentamicin (G) and 80 mg/kg gentamicin sulphate (GS) was injected to animals. III. Group (n=6) referred as G + TOE150, 80 mg/kg GS and 150 mg/kg TOE were injected IP to the animals. IV. Group, referred as G+TOE200 (n=6), 80 mg/kg GS and 200 mg/kg TOE were injected IP to the animals. The treatment continued for consecutive 8 days. The animals were tranquilized (xylazine, 10 mg/kg IP) and sacrificed at the end of the 8th day of study.

Collection of Samples

Following decapitation procedure, the testes and cauda epididymidis of the rats were removed from the body and cleaned from adipose or connective tissues with anatomical scissors and tweezers. Cauda epididymal semen samples and testes tissues were collected. Routine semen examinations were performed and oxidative stress levels of testicular tissues were assayed. Reproductive organ weights [total testes weight (TTW) and total cauda epididymides weights (TCEW)] were recorded.

Semen Evaluation

One of cauda epididymidis was used to obtain semen

sample for each animal. For this purpose, randomly selected cauda epididymidis was minced in Petri dish including 5 mL of physiological saline. To provide the migrations of spermatozoa from cauda epididymidis to fluid, the solution-tissue mixture was incubated in a warmed stage at 35°C for 5 min. Following the incubation period, cauda epididymidis residue was removed by using anatomical tweezers from the Petri dish. The fluid remaining in the Petri dish was used as semen sample. Evaluation of semen was conducted using routine spermatological parameters including motility, dead sperm rate and morphological examination of spermatozoa. To evaluate the percentage of sperm motility, light microscope (Primo Star; Carl Zeiss, Oberkochen, Germany) equipped with the heated stage was used. Briefly, a slide was placed on a heated stage warmed up to 35°C placed on a conventional light microscope. Approximately 20 µL of semen sample was dropped on the slide. The percentage of sperm motility was detected by visual investigation of the sample. To estimate the sperm motility, randomly selected three different fields from each sample were evaluated. The average of three field estimations was calculated as the final motility score of the sample [15,16].

To determine the percentage of morphological abnormality of spermatozoa, the method (with a little modification by using only eosin dye instead of eosin-nigrosin dye) described by Turk et al.[15] was used. Briefly, two slides for each semen sample were stained with eosin dye. Then, the slides were evaluated under light microscope at 400x magnification with the help of immersion oil (immersion oil for microscopy type A, no: 1.515; Nikon, Tokyo, Japan). Two hundred spermatozoa from each slide were examined and the numbers of spermatozoa with abnormal head were expressed as percentage.

Sperm viability was evaluated with light microscope at 400x magnification with the help of immersion oil (immersion oil for microscopy type A, no: 1.515; Nikon, Tokyo, Japan) after eosin nigrosin staining [17]. The smear was prepared for counting. A total of 200 cells were counted and the results are presented as percentages.

Biochemical Evaluations of Testicular Tissues

For assaying the levels of MDA, GSH and the activities of SOD, CAT, the homogenates were centrifuged for 15 min at 1000 g at +4°C while to assay the GPx activity of testicular homogenates were centrifuged for 20 min at 9.000 g at +4°C. Following the centrifugation process, the obtained supernatant was subjected to enzyme assays as soon as possible. The homogenisation of testicular tissues was carried out in Teflon-glass homogenizer with a buffer containing 1.15% KCl to obtain 1:10 (w/v) whole homogenate.

The malondialdehyde (MDA) level of testicular tissues was measured by the thiobarbituric acid reaction method of Placer et al.[18]. The values of MDA were expressed as nmol/g^{-1} tissue. The CAT activity of testicular tissue was determined according to the method of Goth [19]. The values of CAT were expressed as kU/g^{-1} protein. The SOD activity of testes was measured as the level of decrease in the absorbance at 560 nm and SOD values of testicular homogenates were expressed as EU/mg protein. To assay superoxide dismutase (SOD) activity of testicular tissues, the method of Sun et al.[20] was used. The GPx activity of testes was determined using the method of Matkovics et al.[21]. The GPx activity of testicular homogenates was expressed as U/mg protein. The GSH content of testicular homogenates was determined at 412 nm according to the method; described by Ball [22], Fernandez and Videla [23]. GSH levels were expressed as mmol/ g^{-1} tissue. The protein content of the testicular tissues was measured according to the method described by Lowry et al.[24].

Statistical Analysis

Statistical comparisons of data were analysed using General Linear Model/Repeated Measures (SPSS, Version IBM 20.0 Microsoft, Chicago, IL, USA) in-group comparisons. Data were expressed as mean±standard error of the mean (SEM). Differences were considered significant when $P<0.05$.

RESULTS

In *Table 1*, motility of G group was significantly lower when compared to control group ($P<0.01$). There were no differences in terms of dead sperm rate, viable sperm rate, total abnormality, TTW and TCEW among all groups ($P>0.05$). In *Fig. 1*, MDA level of G group was significantly higher than in control and treatment groups ($P<0.01$). In *Fig. 2-3*, glutathione peroxidase (GPx) and glutathione (GSH) levels in G group were lower than the other groups

Table 1. *The values (Mean ±SEM) of reproductive (spermatological and testicular) parameters in male rats used*
Tablo 1. *Kullanılan erkek ratların reprodüktif (spermatolojik ve testiküler) parametre değerleri (Ortalama± SEM)*

Groups	Motility (%)	Viability Rate (%)	Dead Rate (%)	Abnormal Head Rate (%)	Testis Weight (g)	Cauda Epididymal Weight (g)
Control	62.30±1.10^{c}	29.80±0.93	41.78±1.76	13.08±1.27	2.91±0.06	0.41±0.01
G	44.03±1.78^{a}	27.58±0.16	37.58±2.56	13.65±1.41	2.85±0.01	0.42±0.02
GT150	52.80±1.26^{b}	26.53±0.14	45.68±2.57	12.00±0.80	2.75±0.08	0.39±0.03
GT200	48.48±1.69^{ab}	26.96±0.92	37.81±1.84	13.73±1.65	2.77±0.07	0.41±0.02
P	**	--	--	--	--	--

*$^{a-c}$ The values represented by different letters within the same row are significantly different from each other, ** P<0.01*

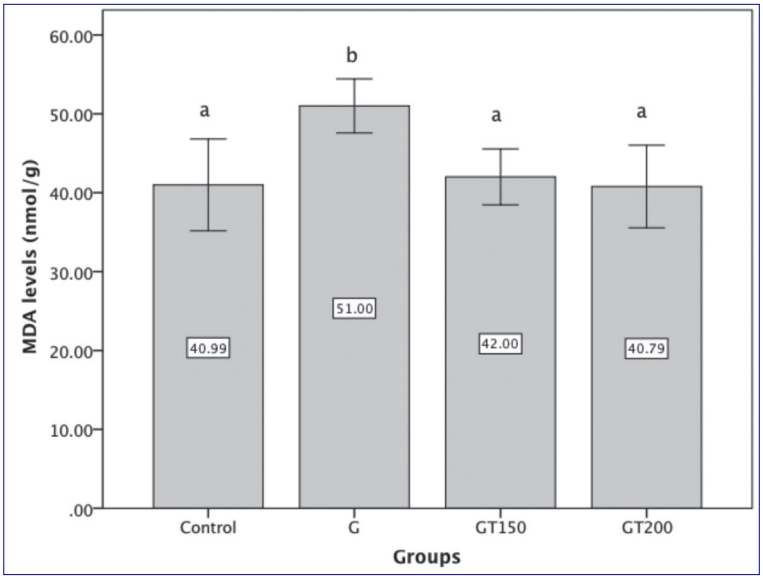


Fig 1. Mean malondialdehyde values (±SEM) of the groups studied

(a-b): Different letters on the columns indicate the statistical differences (P<0.01); G: Gentamicin; GT150: 80 mg/kg gentamicin sulphate and 150 mg/kg *Taraxacum officinale* extract; GT200: 80 mg/kg gentamicin sulphate and 200 mg/kg *Taraxacum officinale* extract

Şekil 1. Çalışılan gruplardaki ortalama malondialdehit değerleri (±SEM)

(a-b): Sütunlardaki farklı harfler istatistiksel farklılıkları belirtir (P<0.01); G: Gentamisin; GT150: 80 mg/kg gentamisin sulfat ve 150 mg/kg *Taraxacum officinale* ekstrakt; GT200: 80 mg/kg gentamisin sulfat ve 200 mg/kg *Taraxacum officinale* ekstrakt

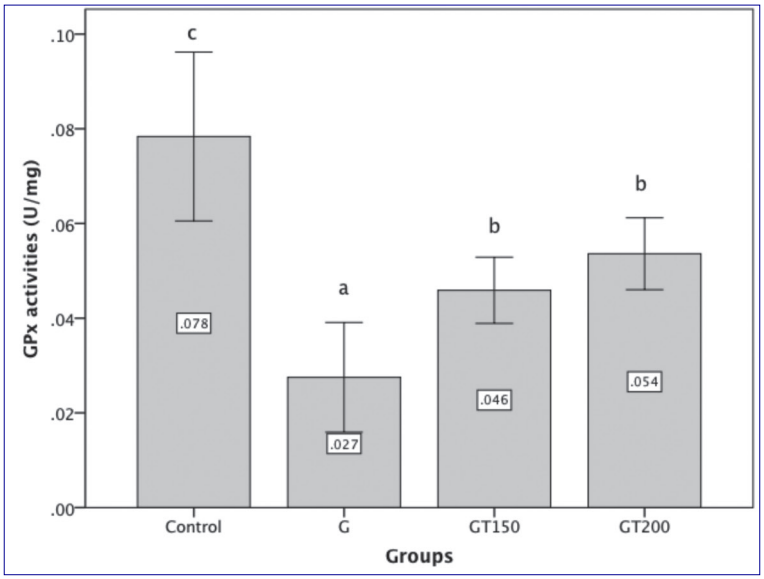


Fig 2. Mean glutathione peroxidase values (±SEM) of the groups studied

(a-b): Different letters on the columns indicate the statistical differences (P<0.01); G: Gentamicin; GT150: 80 mg/kg gentamicin sulphate and 150 mg/kg *Taraxacum officinale* extract; GT200: 80 mg/kg gentamicin sulphate and 200 mg/kg *Taraxacum officinale* extract

Şekil 2. Çalışılan gruplardaki ortalama glutatyon peroksidaz değerleri (±SEM)

(a-b): Sütunlardaki farklı harfler istatistiksel farklılıkları belirtir (P<0.01); G: Gentamisin; GT150: 80 mg/kg gentamisin sulfat ve 150 mg/kg *Taraxacum officinale* ekstrakt; GT200: 80 mg/kg gentamisin sulfat ve 200 mg/kg *Taraxacum officinale* ekstrakt

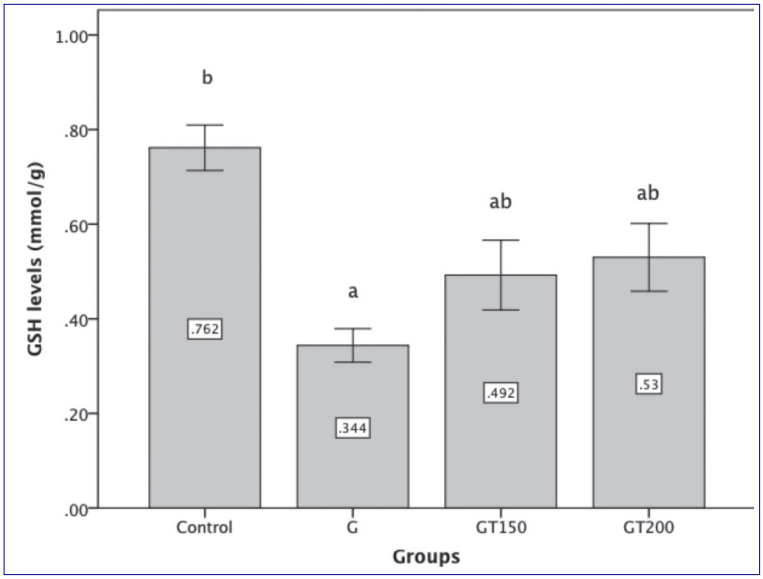


Fig 3. Mean glutathione values (±SEM) of the groups studied

(a-b): Different letters on the columns indicate the statistical differences (P<0.01); G: Gentamicin; GT150: 80 mg/kg gentamicin sulphate and 150 mg/kg *Taraxacum officinale* extract; GT200: 80 mg/kg gentamicin sulphate and 200 mg/kg *Taraxacum officinale* extract

Şekil 3. Çalışılan gruplardaki ortalama glutatyon değerleri (±SEM)

(a-b): Sütunlardaki farklı harfler istatistiksel farklılıkları belirtir (P<0.01); G: Gentamisin; GT150: 80 mg/kg gentamisin sulfat ve 150 mg/kg *Taraxacum officinale* ekstrakt; GT200: 80 mg/kg gentamisin sulfat ve 200 mg/kg *Taraxacum officinale* ekstrakt

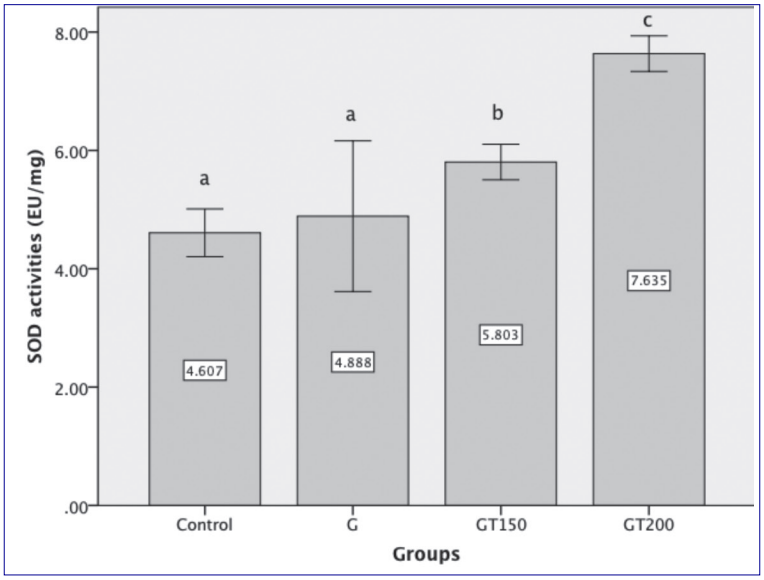


Fig 4. Mean superoxide dismutase values (±SEM) of the groups studied

(a-b): Different letters on the columns indicate the statistical differences (P<0.01); G: Gentamicin; GT150: 80 mg/kg gentamicin sulphate and 150 mg/kg *Taraxacum officinale* extract; GT200: 80 mg/kg gentamicin sulphate and 200 mg/kg *Taraxacum officinale* extract

Şekil 4. Çalışılan gruplardaki ortalama süperoksit dismutaz değerleri (±SEM)

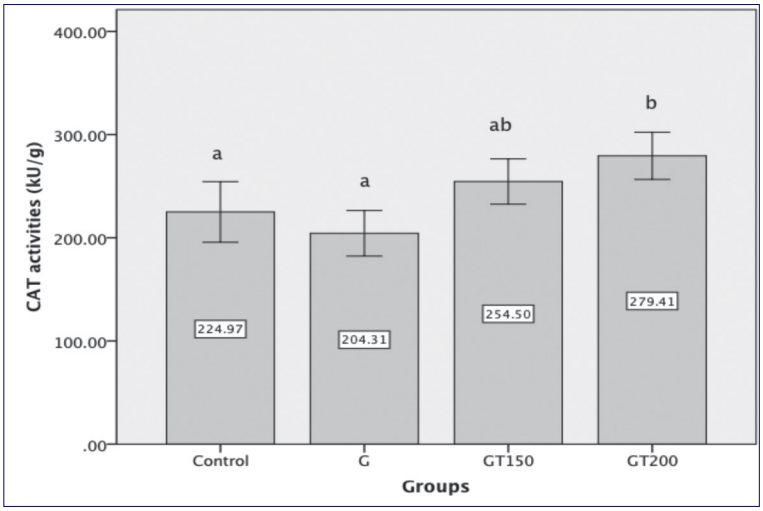
(a-b): Sütunlardaki farklı harfler istatistiksel farklılıkları belirtir (P<0.01); G: Gentamisin; GT150: 80 mg/kg gentamisin sulfat ve 150 mg/kg *Taraxacum officinale* ekstrakt; GT200: 80 mg/kg gentamisin sulfat ve 200 mg/kg *Taraxacum officinale* ekstrakt

Fig 5. Mean catalase values (±SEM) of the groups studied

(a-b): Different letters on the columns indicate the statistical differences (P<0.01); G: Gentamicin; GT150: 80 mg/kg gentamicin sulphate and 150 mg/kg *Taraxacum officinale* extract; GT200: 80 mg/kg gentamicin sulphate and 200 mg/kg *Taraxacum officinale* extract

Şekil 5. Çalışılan gruplardaki ortalama katalaz değerleri (±SEM)

(a-b): Sütunlardaki farklı harfler istatistiksel farklılıkları belirtir (P<0.01); G: Gentamisin; GT150: 80 mg/kg gentamisin sulfat ve 150 mg/kg *Taraxacum officinale* ekstrakt; GT200: 80 mg/kg gentamisin sulfat ve 200 mg/kg *Taraxacum officinale* ekstrakt



(P<0.001, P<0.05; respectively). In *Fig. 4*, the lowest SOD levels were found in control and G groups while the highest level was in GMT200 group (P<0.001). In *Fig. 5*, the CAT activity was found lower in G group than the all other groups (P<0.001).

DISCUSSION

It has been shown that *Taraxacum officinale* extract obtained from its flower inhibits the damage resulting from reactive oxygen species, protects DNA from ROS and has influence on nitric oxide damage [25,26].

There are limited literature data demonstrating the efficacy of *Taraxacum officinale* extract on reproductive parameters in rats. Due to restricted literature data our findings generally were interpreted by comparison with different texture parameters.

In a study conducted by sublethal dose of dandelion extract, Tahtamouni et al.[27] carried out the aqueous extract of *Taraxacum officinale* orally to adult male rats for 60 days in two different sublethal doses; 1/10 LD50 as high dose and 1/20 LD50 as low dose (n=11). The average percentage of sperm showing progressive motility showed a marked decrease in both the low and high dose-receiving groups (33.9±7.8% and 30.7±7.8%, respectively) in comparison to the control group (85.1±6.2%) ($P \leq 0.0001$). In addition, the percentage of sperm with normal morphology decreased significantly in the low- and high dose-receiving groups (85.3±7.6% and 78.9±6.1%, respectively) as compared to the control group (95.2±6.1%) ($P \leq 0.0001$).

In this study, GS decreased sperm motility in comparison with the control group. However, 150 mg/kg but not 200 mg/kg TOE administration to GS-treated rats reversed the reduction in sperm motility when compared with the G group. Our results demonstrated gentamicin produces increase in MDA levels (P<0.01) but decreases the activities of SOD, GPx, catalase and GSH levels. So, it is concluded gentamicin induces functional defect of spermatozoa. Besides, it is thought that the elimination of the reactive

oxygen species is related to antioxidant activity of TOE. On the other hand, it can be expressed that 200 mg/kg TOE administration has toxic effect on sperm motility.

The most important product of lipid peroxidation is MDA. MDA occurs as a result ofthe peroxidation of fatty acids comprising three or more double bonds. MDA acts on the ion-exchange through the cell membranes, leads to crosslinking of the compounds in the membrane and provokes the adverse consequences such as alteration of the ion permeability and the enzyme activity [28].

Sumanth and Rana [29] determined that alcohol extract of the *Taraxacum officinale* roots in dose of 100 mg/kg orally, significantly decreased the level of MDA compared to toxicity group ($P<0.01$). Furthermore it was observed that when toxicity group compared to the control group, the level of MDA significantly elevated ($P<0.001$). Similarly, in the present study, while GS significantly increased the MDA level in comparison with the control group, both doses of TOE significantly decreased the increments in MDA level induced by GS when compared with the G group. Because of gentamicin induced oxidative stress in connection with the ascorbic acid mobilization from testis, it can be mentioned the increasing of free radical formation and lipid peroxidation [10-12]. In spite of that, due to the elimination of the reactive oxygen species by TOE [7], it was observed that the decreasing of MDA level.

GSH wards off the radical species such as superoxide radicals and hydrogen peroxide and protects the membrane protein thiols [30]. Sumanth and Rana [29] reported that 100 mg/kg, but not 50 mg/kg *Taraxacum officinale* roots application provided significant increase in GSH level when compared with the toxicity group. Despite of the dose and mode of administration differences, in terms of effectiveness, the current study is in agreement with this result.

GPx is one of the metalloenzymes (glutathione peroxidase) that capable of removing hydrogen peroxide by converting the oxidized glutathione to reduced glutathione and containing selenium and partly availability in cell membrane. GPx also can restrict the chain reaction of lipid peroxidation by removing the lipid hydroperoxides from cell membrane [31,32].

It was observed that 100 mg/kg dose of alcohol extract from *Taraxacum officinale* roots significantly increase the GPx level compared to the toxicity group ($P<0.001$). In addition, when toxicity group compared to the control group, it was observed significantly decreased in GPx level ($P<0.001$) [29]. There is further study about the increasing level of GPx by the using of hepatoprotective plants [33]. In other study, It was determined that significant increasing in the level of glutathione peroxidase of dandelion group when control group compared to the group of aqueous extract of dandelion leaves [34]. As for our study, groups of GT150 and GT200 ameliorated the GPx level compared to the group of applied solely gentamicin.

CAT convert the harmful hydrogen peroxide to water and oxygen and protects tissues from highly reactive hydroxyl radical [35]. In a study of the application of water extract of dandelion leaves [34], the increasing of CAT level in dandelion groups is in agreement with current study.

As the prime antioxidant enzymes, SOD, can prevent oxidative stress and preventing free radical-induced cellular damage though catalyzing the dismutation reaction of reactive oxygen species (ROS) into oxygen (O_2) and H_2O_2 in biological systems [36-38].

In a study, it was observed that alcohol extract of the *Taraxacum officinale* roots in dose of 100 mg/kg, significantly increased the level of liver SOD compared to toxicity group ($P<0.001$) and in dose of 50 mg/kg, increased at the rate of $P<0.01$. Furthermore it was determined that when toxicity group compared to the control group, the level of SOD significantly decreasing ($P<0.001$) [29]. In the present study, treatment group improved the level of SOD significantly, compared to the groups of gentamicin and control.

Gentamicin have negative effects on testis architecture and germinal cells damages in rats [39]. In our study, reduction of the motility by gentamicin correspond to result of Khaki et al.[39]. Otherwise, gentamicin also caused a significant ($P<0.05$) alteration in plasma and liver enzymatic (catalase, glutathione and super oxygen dehydrogenises) and non-enzymatic (glutathione and vitamin C) antioxidant indices with concomitant increase in the malondialdehyde content; however, there was a significant ($P<0.05$) restoration of the antioxidant status coupled with significant ($P<0.05$) decrease in the tissues' malondialdehyde content, following consumption of diets containing garlic [40].

In nephrotoxicity studies, gentamicin (80 mg/kg - IP, 100 mg/kg - IP; respectively) elevated the serum level of the MDA in the renal tissue, while it decreased CAT, SOD activities and GSH levels in rats [41,42]. Although studied in different tissues, obtained results support our findings in terms of efficacy.

Ghosh and Dasgupta [10], determined that gentamicin induced the ascorbic acid mobilization from testis and by this way decrease of the reproductive potential. By the way, ascorbic acid is one of the water-soluble antioxidants that present in citrus fruits, vegetables and strawberries [43]. As known, ascorbic acid has a protective role against toxic agents -induced histological changes in tissues such as liver, kidney, lungs and testis, bone marrow in rats [44].

In conclusion, short-term administration of GS causes lipid peroxidative damages in testes as well as decreases in sperm motility. However, TOE has a moderate ameliorative effect on sperm motility reductions, but marked improvement effect on lipid peroxidative testicular

damages induced by GS. It is thought that TOE could be an alternative administration to drugs which have common features with TOE but including side effects. It is expected that the obtained results will contribute to the literature.

Acknowledgement

The authors would like to thank to Ataturk University for funding this research (Ataturk University Scientific Research Office, Project Number: 2013/251).

REFERENCES

1. Simon JE: Essential oils and culinary herbs. **In,** Janick J, Simon JE (Eds): Advances in New Crops, 472-483. Timber Press, Portland, OR, 1990.

2. Akeel M: Teb Al-emam *Ali*. 1st ed, Dar Al-Mahaga "El-bedaa", 100-105, Burit, Lebanon, 1996.

3. Saad SI: Classification of flowering plants. 2nd ed., The General Egyption Book Co, Alexandria, 1975.

4. Champe PC, Harvey RA, Ferrier DR: Lippincott's Illustrated Reviews: Biochemistry. 3rd ed., Nobel, Turkey, 2007.

5. Kuntz E, Kuntz HD: Hepatology Textbook and Atlas. 3rd ed., Springer Press, Germany, 2008.

6. Nassimy MN: The prophetic medicine 'Al Teb Al-Nabawy and Modern Medicine. The United Comp. For dist. Damascus, Syria, 1984.

7. Hu C, Kitts DD: Dandelion *(Taraxacum officinale)* flower extract suppresses both reactive oxygen species and nitric oxide and prevents lipid oxidation *in vitro. Phytomedicine*, 12, 588-597, 2005. DOI: 10.1016/j.phymed.2003.12.012

8. Roberts G: Gentamicin Commonwealth Department of Human Services and Health, 27, Canberra, Australia, 2003

9. Ghosh S, Dasgupta S: Gentamicin sulphate induced alterations in phosphatase activities in the reproductive system of male rats. *Med Sci Res,* 20, 717-718, 1992.

10. Ghosh S, Dasgupta: Gentamicin induced inhibition of steroidogenic enzymes in rat testis. *Indian J Physiol Pharmacol,* 43, 247-250, 1999.

11. Narayana K: An aminoglycocide antibiotic gentamycin induces oxidative stress,reduces antioxidant reserve and impairs spermatogenesis in rats. *J Toxicol Sci,* 33, 85-96, 2008. DOI: 10.2131/jts.33.85

12. Akondi RB, Akula A, Challa SR: Protective effects of rutin and naringin on gentamycin induced testicular oxidative stress. *Eur J Gen Med,* 8, 57-64, 2011.

13. Badade ZG, More K, Narshetty J: Oxidative stress adversely affects spermatogenesis in male infertility. *Biomed Res,* 22, 323-328, 2011.

14. Agarwal A, Saleh RA, Bedaiwy MA: Role of reactive oxygen species in the pathophysiology of human reproduction. *Fertil Steril,* 79, 829-843, 2003. DOI: 10.1016/S0015-0282(02)04948-8

15. Turk G, Atessahin A, Sonmez M, Ceribasi AO, Yuce A: Improvement of cisplatin - induced injuries to sperm quality, the oxidant-antioxidant system, and the histologic structure of the rat testis by ellagic acid. *Fertil Steril,* 89, 1474-1481, 2008.

16. Aksu EH, Ozkaraca M, Kandemir FM, Omur AD, Eldutar E, Kucukler S, Comaklı S: Mitigation of paracetamol-induced reproductive damage by chrysin in male rats via reducing oxidative stress. *Andrologia*, 1-10, 2016 (In press). DOI: 10.1111/and.12553

17. Akyol N, Azkur AK, Ekici H: Comparison of flow cytometric analysis and eosin-nigrosin staining methods for determining some morphologica characteristics of bull epididymal spermatozoa. *Kafkas Univ Vet Fak Derg,* 21, 659-664, 2015. DOI: 10.9775/kvfd.2015.13008

18. Placer ZA, Cushman LL, Johnson BC: Estimation of product of lipid peroxidation (malonyldialdehyde) in biochemical systems. *Anal. Biochem,* 16, 359-364, 1966. DOI: 10.1016/0003-2697(66)90167-9

19. Goth L: A simple method for determenation of serum catalase activity and revision of reference range. *Clin Chim Acta,* 196, 143-152, 1991. DOI: 10.1016/0009-8981(91)90067-M

20. Sun Y, Oberley LW, Li Y: A simple method for clinical assay of superoxide dismutase. *Clin Chem*, 34, 497-500, 1988.

21. Matkovics B, Szabó L, Sz Varga I: Determination of enzyme activities in lipid peroxidation and glutathione pathways (in Hungarian). *Laboratóriumi Diagnosztika*, 15, 248-250, 1988.

22. Ball CR: Estimation and identification of thiols in rat spleen after cysteine or glutathione treatment: Relevance to protection against nitrojen mustards. *Biochem Pharmac,* 15, 809-816, 1966. DOI: 10.1016/0006-2952(66)90157-2

23. Fernandez V, Videla LA: Effect of acute and chronic ethanol ingestion on the content of reduced glutathione of varios tissues of the rat. *Experientia,* 37, 392-394, 1981. DOI: 10.1007/BF01959881

24. Lowry OH, Rosebrough NJ, Farr AL, Randall RJ: Protein measurement with folin reagent. *J Biol Chem,* 193, 265, 1951.

25. Schütz K, Carle R, Schieber A: Taraxacum - A review on its phytochemical and pharmacological profile. *J Ethnopharmacol,* 107, 313-323, 2006. DOI: 10.1016/j.jep.2006.07.021

26. Hu C, Kitts DD: Luteolin and luteolin-7-O-glucoside from dandelion flower suppress iNOS and COX-2 in RAW264.7 cells. *Mol Cell Biochem,* 265, 107-113, 2004. DOI: 10.1023/B:MCBI.0000044364.73144.fe

27. Tahtamouni LH, Alqurna NM, Al-Hudhuda MY, Al-Hajj HA: Dandelion *(Taraxacum officinale)* decreases male rat fertility *in vivo. J Ethnopharmacol,* 135, 102-109, 2011. DOI: 10.1016/j.jep.2011.02.027

28. Kalender S, Kalender Y, Öğütçü A, Uzunhisarcıklı M, Durak D, Açıkgöz F: Endosulfan-induced cardiotoxicity and free radical metabolism in rats: The protective effect of vitamin E. *Toxicology*, 202, 227-235, 2002. DOI: 10.1016/j.tox.2004.05.010

29. Sumanth M, Rana AC: *In vivo* antioxidant activity of hydroalcoholic extract of *Taraxacum officinale* roots in rats. *Indian J Pharmacol,* 38, 54, 2006.

30. Mitchell JR, Jollow DJ, Potter WZ, Gillette JR, Brodie BB: Acetaminophen-induced hepatic necrosis. IV. Protective role of glutathione. *J Pharmacol Exp Ther,* 187, 211-217, 1973.

31. Sising R, Pathak DN: Lipid peroxidation and glutathione peroxidase, and glutathione reductase, superoxide dismutase, catalase and glucose-6-phosphate dehydrogenase activities in $FeCl_3$-induced epileptogenic foci in the rat brain. *Epilepsia,* 31, 15-26, 1990. DOI: 10.1111/j.1528-1157.1990.tb05354.x

32. Jung K, Henke W: Developmental changes of antioxidant enzymes activity in kidney and liver from rats. *Free Radic Biol Med,* 20, 613-617, 1996. DOI: 10.1016/0891-5849(95)02090-X

33. Hassan HA, Yousef MI: Ameliorating effect of chicory *(Cichorium intybus* L.) -supplemented diet against nitrosamine precursors-induced liver injury and oxidative stress in male rats. *Food Chem Toxicol*, 48, 2163-2169, 2010.

34. Cho SY, Oh YJ, Park JY: Effect of dandelion *(Taraxacum officinale)* leaf extracts on hepatic antioxidative system in rats fed high cholesterol diet. *J Korean Soc Food Sci Nutr,* 2, 458-463, 2003.

35. Chance B, Greenstein DS, Roughton FJW: The mechanism of catalase actions. I. Steady state analysis. *Arch Biochem Biophys,* 37, 301-321, 1952. DOI: 10.1016/0003-9861(52)90194-X

36. Vaughan M: Oxidative modification of macromolecules minireview series. *J Biol Chem,* 272, 18513-18514, 1997.

37. Umasuthan N, Bathige SD, Revathy KS, Lee Y, Whang I, Choi CY, Park HC, Lee J: A manganese superoxide dismutase (MnSOD) from *Ruditapes philippinarum*: comparative structural- and expressional-analysis with copper/zinc superoxide dismutase (Cu/ZnSOD) and biochemical analysis of its antioxidant activities. *Fish Shellfish Immun*, 33, 753-765, 2012. DOI: 10.1016/j.fsi.2012.06.024.

38. Zelko IN, Mariani TJ, Folz RJ: Superoxide dismutase multigene family: A comparison of the CuZn-SOD (SOD1), Mn-SOD (SOD2), and EC-SOD (SOD3) gene structures, evolution, and expression. *Free Radic Biol Med,* 33, 337-349, 2002. DOI: 10.1016/S0891-5849(02)00905-X

39. Khaki A, Saeid FR, Hamadeh M: Ultra structural study of aminoglycosides (gentamicin) and fluoroquinolone (ofloxacin) antibiotics effect on testis tissue in rats: Light and transmission electron microscopic study. *Toxicol Lett,* 189, S143, 2009 (Abstract). DOI: 10.1016/j.toxlet.2009.06.806

40. Ademiluyi AO, Oboh G, Owoloye TR, Agbebi OJ: Modulatory effects of dietary inclusion of garlic *(Allium sativum)* on gentamycin-induced hepatotoxicity and oxidative stress in rats. *Asian Pac J Trop Biomed,* 3, 470-475, 2013. DOI: 10.1016/S2221-1691(13)60098-2

41. Abdelsameea AA, Mohamed AM, Amer MG, Attia SM: Cilostazol attenuates gentamicin-induced nephrotoxicity in rats. *Exp Toxicol Pathol,* (In press) 2016. DOI: 10.1016/j.etp.2016.01.002

42. El-Kashef DH, El-Kenawi AE, Suddek GM, Salem HA: Protective effect of allicin against gentamicin-induced nephrotoxicity in rats. *Int Immunopharmacol,* 29, 679-686, 2015. DOI: 10.1016/j.intimp.2015.09.010

43. Bowman GL: Ascorbic acid, cognitive function, and Alzheimer's disease: A current review and future direction. *Biofactors,* 38, 114-122, 2012. DOI: 10.1002/biof.1002

44. Shokouhi G, Hadidchi S, Ghorbanihaghjo A, Rahbani-Noubar M, Panahi S, Forouzanfar M, Rashtchizadeh N, Mesgariet FM: Neuroprotective effect of ascorbic acid in experimental blunt sciatic nerve injury in rats. *Internet J Nutr Wellness,* 1, 1-5, 2004.