



Effects of adding Powdered Arugula (*Eruca sativa*) Seed on some of Physiological and biochemical blood Parameters in local Male Rabbits under Oxidative Stress...

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ABSTRACT

This study focused on the preventive effects of powdered Arugula (*Eruca sativa*) seeds on some physiological and biochemical parameters in male local rabbits that were stressed by adding 1% hydrogen peroxide (H₂O₂). The purpose of this experiment was to investigate the protective function of *E. sativa* seeds against oxidative stress caused by 1% H₂O₂. 32 male rabbits from the area were divided randomly into four groups (8 rabbits/treatment). The experimental diets were: T1=control group, T2=adding 3g/kg diets of *E. sativa* seeds powder, T3=adding 1% of H₂O₂ in water, T4=adding 3g/kg diets of *E. sativa* seeds powder and 1% of H₂O₂ in water. At 42 days into the experiment, blood samples were also taken, and the following parameters were measured: HG, MCV, MCH, and MCHC in blood (RBCs), Total number of WBCs, lymphocyte, neutrophils, MID percentage. Immunoglobulin (IgG and IgM) levels, Urea, Creatinine and testosterone. According to our findings, administering 1% H₂O₂ significantly ($P \leq 0.05$) reduced the amount of total RBCs, HG, MCV, MCH, MCHC, IgG and IgM. Significantly increased the levels of urea and creatinine compared to other treatments. The results also showed that adding 3g/Kg diet of rocket (*E. sativa*) seeds resulted in a significant ($P \leq 0.05$) decrease in urea and creatinine and an increase in the mean values of RBCs, HG, MCV, MCH, and MCHC, as well as IgG and IgM. These results suggested that administering 1% hydrogen peroxide/water causes oxidative stress, and leads to an increase in urea and creatinine, and a decrease in MCV, MCH and MCHC. Adding *E. sativa* caused decreased levels of IgG and IgM and minimised the toxic effect of hydrogen peroxide.

Keywords: *E. sativa* seeds, hydrogen peroxide, oxidative stress, blood, Immunoglobulin..

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INTRODUCTION

In the body, Intermediate products, including reactive oxygen species (ROS), are often present during metabolic activities. ROS have a dual function in that they can be beneficial and detrimental to living things. ROS can have beneficial effects on a range of physiological processes when they are present at moderate or low levels [1]. ROS are primarily created by mitochondria in both healthy and pathological situations, which means that O₂ • can be made by cellular respiration, lipoxygenases (LOX) and cyclooxygenases (COX) during arachidonic acid metabolism, and endothelial and inflammatory cells [2]. Even though these organelles are naturally capable of scavenging ROS [3]. It's important to remember that this does not meet the body's requirement to eliminate the quantity of ROS that mitochondria create [4]. Cells employ an antioxidant defensive mechanism based mainly on enzymatic components, such as superoxide dismutase (SOD), catalase (CAT), and glutathione peroxidase (GPx), to defend themselves from ROS-induced cellular damage [5].

Higher amounts of ROS, on the other hand, can potentially cause oxidative stress, which can be harmful to biomolecules. Oxidative stress is a term used to describe some health problems and tissue damage caused by an imbalance between the production and removal of free radicals [6]. An imbalance between oxidants and antioxidants in favour of the oxidants, leading to a disruption of redox signalling and control and/or molecular damage, "is the definition of "oxidative stress" as it is used globally [7].

There are two ways that ROS can form in cells: enzymatic and non-enzymatic processes. Free radicals are produced by enzymatic processes in the respiratory chain, phagocytosis, prostaglandin synthesis, and the cytochrome P450 system [8]. For instance, a number of cellular oxidase systems, including NADPH oxidase, xanthine oxidase, and peroxidases, are responsible for producing the superoxide anion radical (O₂•⁻). After forming, it takes part in a number of processes that produce different

ROS and RNS, including hypochlorous acid (HOCl), peroxyxynitrite (ONOO⁻), hydrogen peroxide, and hydroxyl radical (OH•) [9-10]. Multiple oxidase enzymes, such as amino acid oxidase and xanthine oxidase, create H₂O₂, a nonradical. The most reactive free radical species in vivo, the hydroxyl radical (OH•), is produced when O₂^{•-} reacts with H₂O₂, using Fe²⁺ or Cu⁺ as a catalyst (Fenton reaction) [11].

On the other side of the redox balance, an antioxidant network made up of low-molecular-mass antioxidants and various antioxidant enzymes working in tandem with their backup systems protects harmful concentrations of oxidants [12].

During the 1990s, when scientists were gradually learning how oxygen-triggered free radical reactions in the body play a major part in ageing-associated chronic diseases, antioxidants became a common term in the nutrition world [13].

It is a popular misconception that so-called antioxidants can prevent the negative consequences of reactive species formation, preventing cancer, inflammation, and ageing. Their mechanisms of action allow them to be divided into several defense lines for their function: Preventive agents (a): these include enzymes like SOD, CAT, and GPX; proteins that bind metals like ferritin and ceruloplasmin; minerals like selenium (Se), copper (Cu), and zinc (Zn); radical scavenging agents (b): these include glutathione, albumin, vitamins C and E, carotenoids, and flavonoids; repair and de novo: these include lipases, proteases, DNA repair enzymes, transferases, and methionine-sulfoxide reductases; and (d) adaptation agents that produce the right antioxidant enzymes and transfer them [14-15].

One of the dietary non-enzymatic antioxidants is food ingredients of medicinal plants. The role that medicinal plants play in preventing and controlling disease has been linked to the antioxidant qualities of their constituents, which are generally referred to as polyphenolic substances. Apart from their antioxidant function, these substances exhibit an extensive range of therapeutic attributes [16].

Because they include chemicals and pharmacological properties in their natural state, herbal and plant extracts play a significant role in modern medicine. Plants have a vast reservoir of structural components found in their secondary metabolites that combine to exhibit a wide range of biological activities. These components include alkaloids, steroids, glycosides, tannins, volatile oils, resins, fixed oils, phenols, and flavonoids, all of which are deposited in different parts of the plant, such as the leaves, bark, flowers, fruits, seeds, and roots [17].

One of these medicinal plants is Arugula (*Eruca sativa*). The chemical composition analysis of *Eruca sativa* seeds revealed percentages of various chemical components falling within ranges consistent with those reported in previous studies related to *Eruca sativa* seed chemical analysis [18]. These substances are extremely important for human and animal health since they are antioxidants and anti-carcinogenic [19].

Flavonoids and phenolic compounds, present in *E. sativa* seeds, can suppress free radicals and exhibit effective antioxidant effects in vitro and in vivo. Additionally, they function as chelating agents, which are chemicals that attract minerals [20]. Because there aren't many studies on the impact of *E. sativa* seeds on the rabbits, the purpose of this study was to find out how well *E. sativa* seed powder protected local rabbits from oxidative stress when they were treated with 1% H₂O₂ through Evaluation of renal function, Estimation of testosterone hormone. Assess the blood for RBC, Hb, MCV, MCH, and MCHC. Determining the immunity status for IgG, IgM, WBC, Lymphocyte, Neutrophils and Mid cells.

MATERIALS AND MEDTHODS

To investigate the impact of *Eruca sativa* seeds on oxidative stress triggered by 1% H₂O₂, and examine various physiological and biochemical parameters in Indigenous Male Rabbits. The experiment was 42 days, with 32 male rabbits divided randomly into four experimental groups, each containing 8 rabbits.

The experimental treatments were administered as follows:

T1= control group

T2= adding 3g/kg diets of *E. sativa* seeds powder. T3= adding 1% of H₂O₂ in water.

T4= adding 3g/kg diets of *E. sativa* seeds powder and 1% of H₂O₂ in water.

Rabbits Management

The animals were situated in cages intended for breeding rabbits; all necessary arrangements were made to ensure suitable heating, cooling, ventilation, and humidity levels. Electric heaters were utilized for warming the premises, while temperature regulation was monitored using a mercury thermometer. Ventilation was facilitated through windows fitted with ventilators and air extractors. Additionally, the cages underwent regular cleaning, sterilization, and sawdust replacement. These cages were housed within a designated hall.

Conducting a feeding trial

Table 1 and Table 2 present the constituents and chemical compositions of the basal mixture and experimental diets utilized in this study. The experimental diets were derived from a standard basal mixture, and the amount of nutrients required was modified by [21] suggestions.

Table 1: Components of the base mixture (%).

Ingredients	(%)
Soybean meal (44% CP)	19.60
Barley	17.10

Wheat bran	25.08
Yellow corn	7.00
Clover hay	24.50
Molasses	3.00
Limestone	1.08
Di- calcium phosphate	1.71
DL-Methionine	0.28
Sodium chloride	0.35
Vit.-Min. premixa	0.30
Total	100

Table 2: Chemical analysis (%DM basis) of the basal mixture.

Chemical analysis (%DM basis)	(%)
Dry matter (DM)	86.89
Organic matter (OM)	90.90
Crude protein (CP)	17.63
Crude fiber (CF)	13.40
Ether extract (EE)	1.90
Nitrogen free extract (NFE)	57.97
Ash	9.10
ADF	17.02
Methionine	0.68
Lysine	0.99
Calcium	1.27
Digestible energy (Kcal/Kg DM) ^a	2599.49

^a in accordance with [26], digestible energy (DE) was computed using the following formula: $DE = 15.627 - 0.0114 MM^2 - 0.169 ADF \pm 1.250 MJ/kg DM + 0.000982 CP^2 + 0.0040 EE^2$. DM = Dry matter; EE = % Ether extract (lipids) in DM; MM = minerals (ash) in DM; ADF = % Acid detergent fiber in DM; CF = % Crude fiber in DM. DE in M Joules /kg DM.

Preparing hydrogen peroxide and powdered *E. sativa* seeds

E. Sativa seeds were bought from the Sulaymaniyah local market, cleaned of contaminants, and ground into a powder using an electric grinder in small amounts. This process also involved the preparation of hydrogen peroxide. Then, combined with a tiny quantity of diet, after homogeneity is achieved, the mixture is combined with the maximum quantity of diet. A 25% concentration of hydrogen peroxide was acquired from nearby pharmacies (manufactured by UAE). Thus, a 1% concentration was achieved using a certain equality.

Blood sample

After the experiment, three male rabbits from each group were chosen at random, starved for 12 hours, and then slaughtered. At the time of killing, five milliliters of blood from each rabbit were drawn into glass tubes that had been heparinized. Centrifugation was used to separate the blood serum for 15 minutes at 3000 rpm. Before the experiment, the collected serum was kept at -20°C.

Statistical analysis

Using SAS® Software Statistical Analysis's general linear model approach, one-way analysis of variance was used to analyse the collected data [22] statistically. Duncan's Multiple Range-Test was used to test for differences in treatment means [23]. This model was used to analyses every result:

$$Y_{ij} = \mu + T_i + E_{ij}$$

Where Y_{ij} represents the observation of ij , μ represents the general mean, T_i represents the effects of i (treatments), and E_{ij} is the experimental random error.

RESULTS

The results in Table (3) demonstrated that, when compared to the other treatments, the total number of erythrocytes in the second treatment (3 g/Kg diet *E. sativa* seeds) increased significantly ($P \leq 0.05$). In contrast, the number of erythrocytes in the third treatment exhibited the lowest significant ($P \leq 0.05$) increase. The hemoglobin level in the blood showed a significant increase ($P \leq 0.05$) in the second treatment (3 g/Kg diet *E. sativa* seeds) when compared to the other treatments; however, the third treatment (1% H₂O₂ treatment group) showed a significant decrease ($P \leq 0.05$) when compared to the other treatments.

As for the MCH and MCHC characteristics, the significant superiority ($P \leq 0.05$) was obtained in the second treatment, in which the *Eruca sativa* seeds (3 mg/kg) were used compared to the rest of the treatments. And for MCV parameter was decreased significantly ($P \leq 0.05$) in the third treatment which hydrogen peroxide (1%) was induced contrasted to the other treatments.

Table 3: Effects of 1% hydrogen peroxide and *E. sativa* seeds on local male rabbits' RBC, HB, MCV, MCH, and MCHC levels (mean \pm SE).

Treatments	RBCs ($\times 10^6/\text{mm}^3$)	HG (g/dl)	MCV (μm^3)	MCH (pg)	MCHC (g/dl)
T1	6.83 \pm 0.03 b	10.53 \pm 0.23 b	66.47 \pm 0.58 a	23.57 \pm 0.31 b	32.80 \pm 0.35 b
T2	7.38 \pm 0.20 a	11.30 \pm 0.25 a	69.68 \pm 0.70 a	25.15 \pm 0.36 a	35.94 \pm 0.43 a
T3	5.46 \pm 0.16 c	9.21 \pm 0.15 c	60.45 \pm 0.89 b	20.65 \pm 0.62 b	30.54 \pm 0.97 c
T4	6.51 \pm 0.19 b	10.69 \pm 0.17 ab	66.15 \pm 2.10 a	23.79 \pm 0.32 b	32.77 \pm 0.31 b

* The treatments T1 (control group), T2 (3 g/Kg diet *E. sativa* seeds), T3 (1% H₂O₂ treatment group), and T4 (3 g/Kg diet *E. sativa* seeds and 1% H₂O₂ treatment group) showed significant ($P \leq 0.05$) changes in the values, which are expressed as mean \pm SE.

* RBCs : red blood cells ; HG :hemoglobin ; MCV: mean corpuscular volume ; MCH: mean corpuscular hemoglobin; MCHC; mean corpuscular hemoglobin concentration

The statistical analysis presented in Table (4) demonstrated that the second treatment, which involved giving rabbits 3g/kg of *Eruca sativa* seeds along with a basal diet, significantly raised ($P \leq 0.05$) the levels of blood IgG and IgM in comparison to all other treatments, while the third treatment, which involved giving them 1% H₂O₂ as a treatment, significantly decreased ($P \leq 0.05$) in comparison to all other treatments. In contrast to the control group, the fourth, third, and second treatments demonstrated a substantial ($P \leq 0.05$) increase in the total count of white blood cells, lymphocyte neutrophils, and mid cells.

Table 4: Effects of 1% hydrogen peroxide and *E. sativa* seeds on some immunity parameters of local male rabbits (mean \pm SE).

Treatments	IgG (mg/dL)	IgM (ng/ml)	WBCs ($\times 10^6/\text{mm}^3$)	Lymphocyte (%)	Neutrophils (%)	Mid (%)
T1	240.25 \pm 11.95 b	27.75 \pm 1.10 b	5.95 \pm 0.27 b	50.55 \pm 3.04 b	33.82 \pm 0.91 b	5.22 \pm 0.20 b

T2	336.25± 17.29 a	38.75± 1.49 a	9.78± 0.14 a	60.42± 0.86 a	39.65±0.42 a	6.70± 0.73 a
T3	164.00± 8.27 c	11.50± 1.04 c	9.81± 0.46 a	60.66± 2.53 a	39.53±1.05 a	6.55± 0.16 a
T4	217.75± 7.88 b	27.00± 1.29 b	9.89± 0.18 a	59.13± 0.94 a	38.79±0.66 a	6.47± 0.08 a

* The Treatment T1 (control group), T2 (3 g/Kg diet *E. sativa* seeds), T3 (1% H₂O₂ treatment group), and T4 (3 g/Kg diet *E. sativa* seeds and 1% H₂O₂ treatment group) showed significant ($P \leq 0.05$) changes in the values, which are expressed as mean \pm SE. *IgG: immunoglobulin G; IgM: immunoglobulin M; WBCs: white blood cells; MID: Mid-cell type of white blood cells (WBCs).

The statistically meaningful results in Table (5) show that the second treatment (3 g/Kg diet *E. sativa* seeds) had a greater significant ($P \leq 0.05$) testosterone level than the other treatments. Regarding the third treatment (1% H₂O₂ treatment group), the levels of creatinine and urea in the blood serum were significantly higher and at a significant level ($P \leq 0.05$) in comparison to the other treatments. Furthermore, in comparison to the other treatments, the amount of urea was the least significant ($P \leq 0.05$) in the second treatment

Table 5: Effects of 1% hydrogen peroxide and *E. sativa* seeds on Testosterone, Urea and creatinine level of local male rabbits (mean \pm SE).

Treatments	Testosterone	Urea (mg/dl)	Creatinine (mg/dl)
T1	2.16± 0.07 b	34.18± 0.51 b	1.05± 0.06 b
T2	3.97± 0.32 a	28.87± 2.45 c	1.05± 0.05 b
T3	2.02± 0.22 b	40.60± 1.88 a	1.75± 0.06 a
T4	2.21± 0.06 b	34.90± 0.97 b	1.12± 0.06 b

* The treatments T1 (control group), T2 (3 g/Kg diet *E. sativa* seeds), T3 (1% H₂O₂ treatment group), and T4 (3 g/Kg diet *E. sativa* seeds and 1% H₂O₂ treatment group) showed significant ($P \leq 0.05$) changes in the values, which are expressed as mean \pm SE.

DISCUSSION

The study's blood parameter data (table 3) indicated that the third group, which received H₂O₂ treatments, had lower levels of RBCs, HG, MCV, and MCHC. These findings concur with [24] and [25].

The causes of the decline in RBCs could include harmful effects of ROS on bone marrow, which produces RBCs [26]. or on kidney tissues by the oxidation of unsaturated fatty acids in cell membranes, which damages the kidneys and lowers the level of the hormone erythropoietin and the generation of red blood cells [27]. The decrease in red blood cells (RBCs) could be caused by the effect of H₂O₂ on the glutathione concentration and oxidation of plasma membrane component [28]. Glutathione is essential for the survival and vitality of RBC membranes; when the body is under oxidative stress, GSH levels are lowered, which results in the loss of the membranes' natural structure and an increase in lipid oxidation of the plasma membrane, which causes hemolysis and reduces RBC concentration [29].

At the same time, treatment of rabbits with 3 g/ Kg diet *E. sativa* seeds powder exhibited increase in red blood cells, hemoglobin, MCV, MCH, and MCHC percentage in blood. These findings are consistent with a large body of prior research that has demonstrated the protective properties of various plants high in polyphenols or vitamin C and E, such as *Coffea Arabica* and vitamin E [30], pomegranate seed oil [31], extracts from *E. sativa* [32], and sour cherries (*Prunus Cerasus* L.) [33].

Furthermore, elevated Hb levels are a result of the iron and vitamin B12, niacin, B6, B2, and B1 that are found in *E. sativa* and are essential for the body's biosynthesis of Hb [34]. Alternatively, elevated Hb levels may result from the antioxidant compounds in *E. sativa* that increase iron absorption and convert Fe⁺³ to Fe⁺² and Cu⁺² to Cu⁺ (monovalent) that are thought

to be important co-enzyme for the production of Hb [35]. Lastly, the elevation could be attributed to vitamin E's function as an antioxidant to preserve the RBCs cell membrane against oxidative agents [36].

Additionally, the study's findings demonstrated that giving 1% H₂O₂ drinking water on a regular basis for 42 days reduced the mean immunoglobulin G and immunoglobulin M values, table (5).

This decrement could be due to that Hydrogen peroxide (H₂O₂) causes oxidative stress, which upsets the body's delicate equilibrium between the generation of reactive oxygen species (ROS) and antioxidant defences. The oxidation of biomolecules, such as proteins like immunoglobulins (IgG and IgM), can be caused by this imbalance [37]. These immunoglobulins are vulnerable to oxidative damage, which compromises their structure and function when exposed to high levels of ROS [38]. Their capacity to identify and neutralise infections may be compromised by such damage, jeopardizing the immunological response of the body.

The present results showed a positive effect of arugula seeds in serum IgG, IgM which lead to increase its level compare to the treatments which didn't fed on arugula (*Eruca sativa*) seeds and that could be due to that Arugula, or *Eruca sativa*, has immunomodulatory properties that may raise the body's levels of immunoglobulin M (IgM) and immunoglobulin G (IgG) [39]. Its characteristics, such its capacity to promote immunity and act as an antioxidant, suggest that it may have a beneficial effect on the immune system [40]. The synthesis and control of immunoglobulin's, such as IgG and IgM, may be improved by these actions.

Table (4) clearly illustrates how all treatments have greatly outperformed the control treatment in terms of the total number of white blood cells, lymphocytes, neutrophils, and mid-cell percentage. This increase in this trait could be attributed to the fact that white blood cells are the body's first line of defence and that their numbers rise sharply in response to infections. Additionally, numerous studies have demonstrated the immunostimulant properties of herbal plants, which may contribute to the increase in white blood cell counts [41].

As we note from Table 5 that, when compared to the other treatments, the addition of 3 gm/kg *Eruca sativa* seeds powder with the basal diet (the second treatment) resulted in a substantial increase in the blood serum level of testosterone at a possible level ($P \leq 0.05$). The effect of polyphenolic flavonoid compounds in *eruca sativa* seeds on the pituitary-testicular axis and subsequent increase in testosterone levels may be the reason for the highest elevation in testosterone observed in the second treatment at the end of the experiment when compared to the other treatments [42]. A few studies revealed that *E. sativa* contains sterols, flavonoids, quercetin, and saponins that scavenge or eliminate FRs and secondary act to improve testicular and fertility functions [43], increasing sexual desire [44].

When compared to the other treatments, the levels of urea and creatinine as showed in the table (5) in the rabbits given hydrogen peroxide exhibited a substantial ($P \leq 0.05$) increase. Our study's findings are consistent with [45]. One of the most significant and accurate ways to diagnose renal function is to measure the levels of creatinine and urea in the blood. Since these parameters are metabolic products reabsorbed in the renal tubules, an increase in their levels indicates abnormal kidney function [46]. The oxidation stress which caused by H₂O₂ treatment may be the cause of elevated urea and creatinine levels. This stress leads to the oxidation of lipids and proteins, specifically the lipid of the renal tubule cells' plasma membrane, which negatively affects the permeability of cell membranes. This increased flow of urea and creatinine from kidney tissues to the blood stream raises levels of both creatinine and urea [29].

Likewise, there was a significant decrease in the mean values of creatinine and urea in the treatment groups for *E. sativa* seeds. These findings are consistent with those of [47], who found that applying an aqueous extract of *E. sativa* leaves, which has protective properties against oxidative stress, lowers the levels of urea and creatinine. [48] suggest that *E. sativa* may have a nephroprotective and diuretic effect, activating the kidney to promote urine excretion, which could explain the improvement in urea and creatinine levels.

Also, providing glucose as a direct energy source rather than proteins lowers the concentrations of both urea and creatinine in serum due to the antioxidant effects of active compounds in *E. sativa*, such as flavonoids and vitamin E, and their role in preventing and reducing the production of free radicals [49].

CONCLUSIONS

BASED ON THE FINDINGS OF THE CURRENT INVESTIGATION, IT WAS DETERMINED THAT:

- Administering 1% hydrogen peroxide/water causes oxidative stress, which results in dyslipidemia, an increase in serum urea and creatinine, and a decrease in mean corpuscular volume (MCV), mean corpuscular haemoglobin (MCH), and mean corpuscular haemoglobin concentration (MCHC). Also lower levels of immunoglobulin G and M in the blood serum.
- To enhance blood parameter status and kidney function in rabbits, *E. sativa* seeds can be added to their diet at a rate of 3 g/kg.
- Treatment with *E. sativa* seeds minimizes the toxic effect of hydrogen peroxide on function of the general body and kidney.
- When *E. sativa* seeds are added to blood serum, the levels of immunoglobulin G and immunoglobulin M rise, boosting body immunity and improving haematological parameters, including RBC and Hb.

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تأثير إضافة مسحوق الجرجير (*Eruca sativa*) على بعض صفات الدم الفسيولوجية والحيوية في ذكور الأرانب المحلية تحت الإجهاد التأكسدي

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ملخص

ركزت هذه الدراسة على الآثار الوقائية لبذور الجرجير المسحوق (*Eruca sativa*) على بعض صفات الدم الفسيولوجية والكيموحيوية في ذكور الأرانب المحلية التي تم إجهادها بإضافة 1 % بيروكسيد الهيدروجين (H_2O_2). تم رعاية الأرانب في مساكن مسيطر عليها بيئياً. كان الغرض من هذه التجربة هو التحقيق في الوظيفة الوقائية لبذور الجرجير ضد الإجهاد التأكسدي الناتج عن 1 % H_2O_2 . تم تقسيم 32 من ذكور الأرانب المحلية بشكل عشوائي إلى أربع معاملات (8 أرانب/علاج). كانت الأنظمة الغذائية التجريبية: T_1 = مجموعة السيطرة، T_2 = إضافة 3 جم/كجم إلى العليقة الأساسية من مسحوق بذور الجرجير، T_3 = إضافة 1 % H_2O_2 إلى الماء، T_4 = إضافة 3 جم/كجم من مسحوق بذور الجرجير و 1 % H_2O_2 إلى الماء. خلال 42 يوماً من التجربة، تم أخذ عينات الدم أيضاً، وتم قياس الصفات التالية: الهيموغلوبين (HG)، متوسط حجم الجسيمات (MCV)، متوسط الهيموغلوبين الجسيمي (MCH)، ومتوسط تركيز الهيموغلوبين الجسيمي ($MCHC$) في الدم (خلايا الدم الحمراء، كرات الدم الحمراء)، العدد الكلي لخلايا الدم البيضاء، اللمفاويات، العدلات، نسبة الخلايا المتوسطة. مستويات الغلوبولين المناعي (IgG و IgM)، وظائف الكلى (اليوريا والكرياتينين)، الهرمونات (التستوستيرون). وفقاً للنتائج التي توصلنا إليها، فإن إعطاء 1 % H_2O_2 بشكل ملحوظ ($P \leq 0.05$) قلل من العدد الكلي لكريات الدم الحمراء، HG ، MCV ، MCH ، $MCHC$ و الغلوبولين المناعي. زيادة كبيرة في مستويات اليوريا والكرياتينين مقارنة بالمعاملات البقية. وأظهرت النتائج أيضاً أن إضافة 3 جم/كجم من مسحوق بذور الجرجير نتج عن انخفاض كبير ($P \leq 0.05$) في اليوريا والكرياتينين وكذلك زيادة في قيم كريات الدم الحمراء، والهيموغلوبين، MCV ، MCH ، $MCHC$ ، وكذلك الغلوبولين المناعي G والغلوبولين المناعي M . وتشير هذه النتائج إلى أن إعطاء 1 % بيروكسيد الهيدروجين/الماء يسبب الإجهاد التأكسدي، ويؤدي إلى زيادة اليوريا والكرياتينين، وانخفاض في العدد الكلي لكريات الدم الحمراء، ومتوسط الهيموغلوبين الجسيمي، ومتوسط تركيز الهيموغلوبين الجسيمي. بالإضافة إلى أن البذور تسبب انخفاض مستويات الغلوبولين المناعي G و M في مصل الدم وتقليل التأثير السام لبيروكسيد الهيدروجين على وظيفة الجسم العام والكلى.

الكلمات المفتاحية: جرجير، بيروكسيد الهيدروجين، الإجهاد التأكسدي، الدم، الغلوبولين المناعي.