Research Article

BASJVETRES

*BASRAH JOURNAL OF VETERINARY RESEARCH,2024, 23(2):110-118*
*https://bjvr.uobasrah.edu.iq/*

# Estimating The Effectiveness of Taurine As An Antioxidant Outside The Body

Zahraa A. Abdulrazaq, Raghdan H. Mohsin.

Department of Animal Production, College of Agriculture, University of Basrah, Basrah, Iraq.

**Corresponding Author Email Address:** raghdan.mohsin@uobasrah.edu.iq

**ORCID ID:** https://orcid.org/0000-0002-4007-5774

**DOI:** https://doi.org/10.23975/bjvr.2024.150315.1091

**Received: 30 May 2024 Accepted: 30 June 2024.**

## Abstract

The study was conducted at the College of Agriculture / Department of Animal Production / University of Basrah. This study aimed to determine if taurine was used as an antioxidant outside the body; it is a non-essential amino acid that contains sulfur. Its chemical formula, $C_2H_7NO_3S$ contains a sulfonate group instead of the carboxyl group. The antioxidant activity was measured using the DPPH radical, measuring the scavenging of hydrogen peroxide, the ability to bind the ferrous ion, and the reducing power. The study results showed that the synthetic antioxidant and the DPPH radical of taurine acid had very different antioxidant activities. Moreover, taurine acid has the ability to scavenge and capture hydrogen peroxide and bind ferrous ions, as the results showed significant superiority ($P<0.05$) over the artificial antioxidant BHT. Taurine also showed a significant increase in its reduced power.

**Keywords:** Taurine acid, Antioxidants, DPPH.

## Introduction

Oxidation is an imbalance in oxidative status that results from the inability to detoxify reactive products that are formed by the production of active species during the process of cellular metabolism, which leads to an increase in free radicals (1). Free radicals are chemical molecules that contain a single electron or a double electron in their outer shell (2).

The active species, ROS and RNS, are constantly distributed throughout the body and occur as side effects of various reactions in the human body under normal conditions. Artificial antioxidants remove these species (3). They are biologically active components that have received the attention of many researchers in pharmacy, medicine, and food engineering (4). It is defined as a group of compounds that can prevent or reduce the oxidation process by preventing the



This is an open access article under the CC BY 4.0 license

production and formation of free radicals (5). Antioxidants are divided into synthetic and natural antioxidants. The most important industrial antioxidants are butylated Hydroxy toluene (BHT), Butylated Hydroxy anisole (BHA), tertiary butylhydroquinone (TBHQ), and gallate (PG). Because of the long-term side effects of artificial antioxidants, which cause carcinogenesis and cellular toxicity, researchers have turned to using natural antioxidants.

Taurine is one of the many natural antioxidants, an amino acid that contains sulfur and contributes to antioxidant defenses in various ways, including scavenging free radicals, maintaining the integrity of the mitochondrial electron transport chain in conditions of oxidative stress, stabilizing biological membranes, and eliminating inflammation (6). Taurine plays a major role, showing biological and protective activity against toxicity in various models of neurodegenerative diseases such as Parkinson's and Huntington's (7). Studies have shown the beneficial effects of taurine acid in alleviating fatty liver disease, as this disease, through its advanced stages, increases the risk of cancer. Researchers have noted that taurine effectively alleviates the effects of fatty liver disease by reducing fat levels and boosting antioxidants to enhance defense against free radicals (8). The study found that taurine reduces oxidative stress in the brain, enhances hormone secretion, and prevents retinopathy and nephropathy, as well as being useful in treating liver and vascular poisoning caused by diabetes (9).

## Materials and Methods

### Estimation of antioxidant activity using DPPH radical:

The antioxidant activity of taurine was estimated using DPPH 2,2- diphenyl -1-picrylhyrazyl radical scavenging according to the method of (10).

Which included:

1- 2 ml of taurine acid was taken and mixed with 2 ml of DPPH at a concentration of 0.1 mM prepared in methanol. The mixture was shaken for a few seconds.

2- Leave the mixture in a dark place at laboratory temperature for 30 minutes.

3- The absorbance of the solution was measured at a wavelength of 517 nm.

4- The control sample was prepared by mixing all materials except taurine.

5-Results were compared with both BHT and ascorbic acid.

According to the following equation:

$$DPPH\% = \frac{\text{Absorbance of the control sample} - \text{read Absorbance of the sample}}{\text{Absorbance of the control sample}} \text{ x100}$$

### Scavenging of hydrogen peroxide

The ability of taurine to seize a hydrogen peroxide radical was estimated according to the method mentioned (11). which included:

1- 1 ml of taurine and 0.6 of 0.002 M hydrogen peroxide prepared in 0.1 M phosphate buffer were taken at a pH of 7.4.

2- The samples were left at laboratory temperature for 10 minutes.

3- Absorbance was measured at a wavelength of 230 nm.

4-Results were compared with BHT and ascorbic acid.

according to the following equation:

$$H_2O_2\% = \frac{\text{Absorbance reading of the control sample} - \text{reading of the sampie}}{\text{Absorbance reading of the control sample}} x100$$

**Measurement of Reducing Power**

The reductive force was estimated according to the method mentioned by(12). which included;

1- 2.5 ml of taurine was mixed with 2.5 ml of 200 mM phosphate buffer solution, pH 6.6, and 2.5 ml of 1% potassium ferricyanide.

2- Leave the mixture in the water bath at 50 degrees Celsius for 20 minutes.

3- The reaction was terminated by adding 2.5 ml of Trichlora acetic acid 10%.

4- The mixture was centrifuged, and 5 ml of distilled water and 1 ml of ferric chloride 0.1% were added.

5- The absorbance of the solution was measured at a wavelength of 700 nm.

6- The results were compared with the synthetic antioxidant BHT and ascorbic acid.

according to the following equation:

Reducing power% =

$$1 - \frac{\text{Absorbance reading of the sample}}{\text{absorbance reading of the control sample}} \times 100$$

**Ferrous ion binding**

The ability of taurine to bind ferrous ions was estimated according to the method mentioned by (12). which included;

1- 0.4 ml of taurine was mixed with 0.4 ml of 2 mM ferrous chloride and 0.4 ml of 8-hydroxy quinoline at a concentration of 5 M, prepared in 98% ethanol.

2- Leave the mixture at laboratory temperature in a dark place for 10 minutes.

3- Absorbance was measured at a wavelength of 562 nm.

4- Results were compared with BHT and ascorbic acid.

according to the following equation:

Ferrous ion binding %

$$=1 - \frac{\text{read the Absorbance of the sample}}{\text{and the Absorbance of the control sample}} x100$$

## Results and Discussion

**Measurement of DPPH free radical scavenging**

The results in Figure 1 showed the ability of taurine to scavenge free radicals (DPPH). The results showed that there were no significant differences ($P<0.05$), as taurine could scavenge free radicals in DPPH at a rate of 93.14% without significant differences ($P<0.05$). The synthetic antioxidants BHT and ascorbic acid showed evidence of scavenging the free radical DPPH by 90.93% and 95.27%, respectively. These results agreed with (13). This shows

that taurine acid possesses radical scavenging activities against hydroxyl radicals and superoxide radicals; the reason that taurine acid scavenges free radicals may be attributed to the fact that taurine acid can donate electrons. Sulfur-containing amino acids may also have excellent antioxidant capabilities and are useful to the food processing industry as antioxidant additives to prolong the shelf life of foods or food products and provide a beneficial pharmacological effect against cell damage caused by oxidation (14).

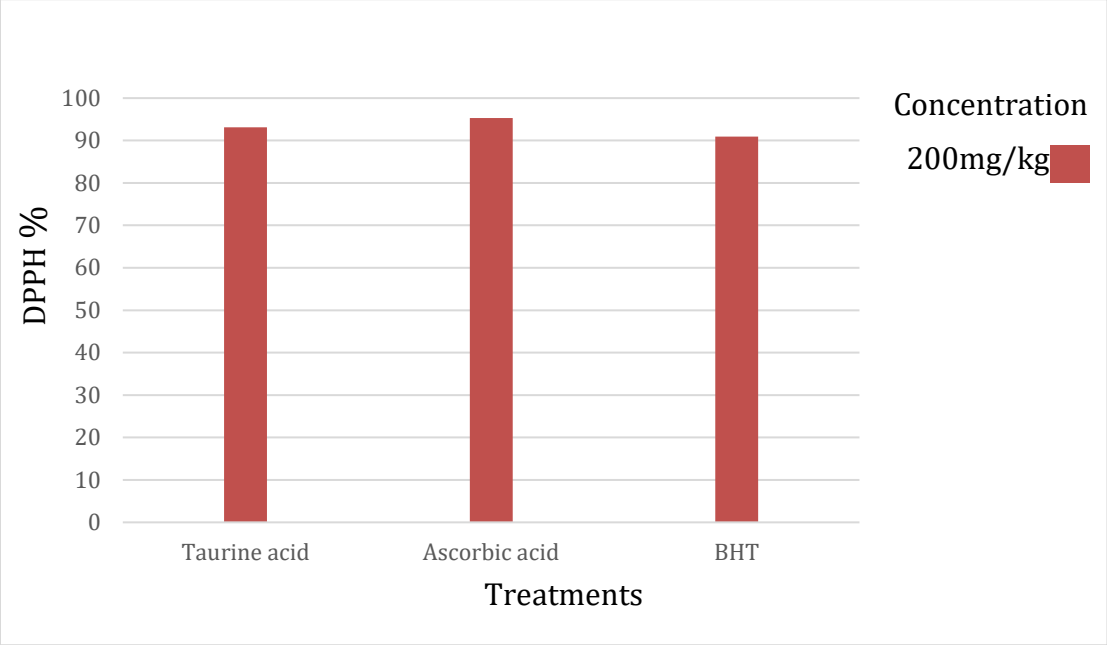


**Figure (1) DPPH Scavenging of taurine free radicals RLSD = 4.33**

## Scavenge ability of hydrogen peroxide

Conversely, results indicated that taurine acid can scavenge hydrogen peroxide (Figure 2), as the ability to scavenge taurine acid reached 91.89%, superior to what was shown by the industrial antioxidant, which reached 83.50%, while ascorbic acid reached 95.84%. From the results, we note a significant superiority ( P< 0.05 ) for taurine acid as an industrial antioxidant and the absence of significant differences between it and ascorbic acid. These results are very important because of the toxicity of hydrogen peroxide formed in cells due to its ability to penetrate cell membranes inside cells. These findings concurred with (15), who confirmed that hydrogen peroxide can inhibit several enzymes by oxidizing basic thiol groups (SH-), which can control the amount of hydrogen peroxide inside the cell.

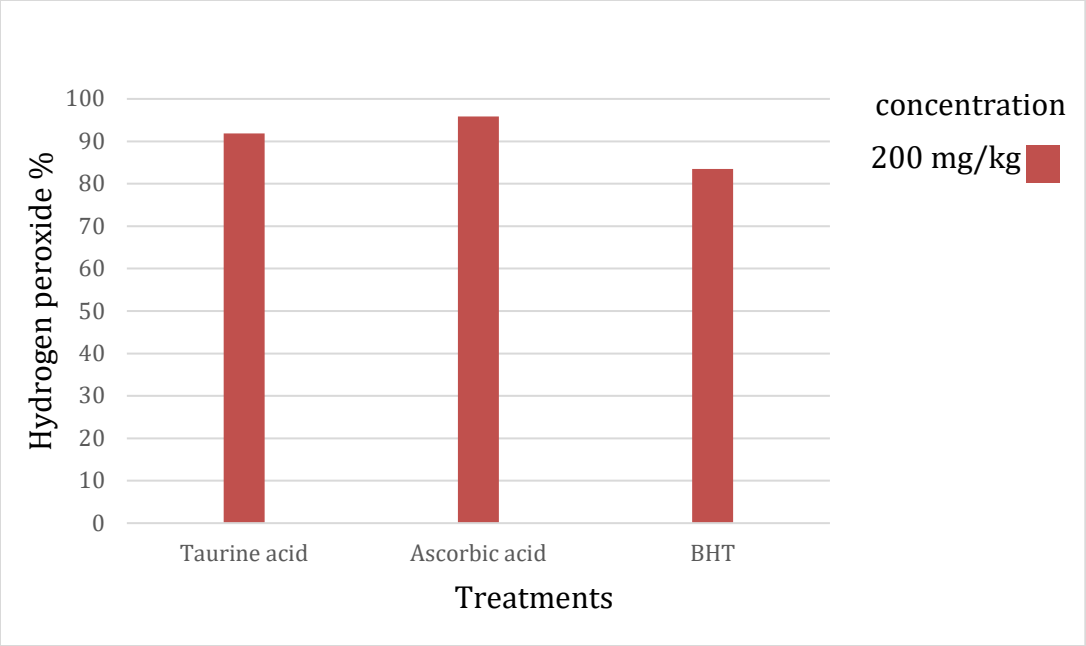


**Figure (2) The ability of taurine acid to capture hydrogen peroxide RLSD = 3.95**

## Measurement of reducing force

The results in Figure 3 showed the reducing power of taurine acid compared to the natural antioxidant ascorbic acid and the artificial antioxidant BHT, which can reduce the ferric ion Fe+3 in the complex [KFe(CN)] potassium ferricyanid to the ferrous ion Fe+2 by giving Electron The results showed that there were significant differences, as taurine acid had a reducing power of 71.99%, which was similar in effect to what was shown by the industrial antioxidant BHT, which reached 80.53%, and ascorbic acid, which reached 89.14%. The intensity of the apparent color indicates the reducing power and the ability of taurine acid to donate electrons because it contains some amino acids that increase the reducing power (16).

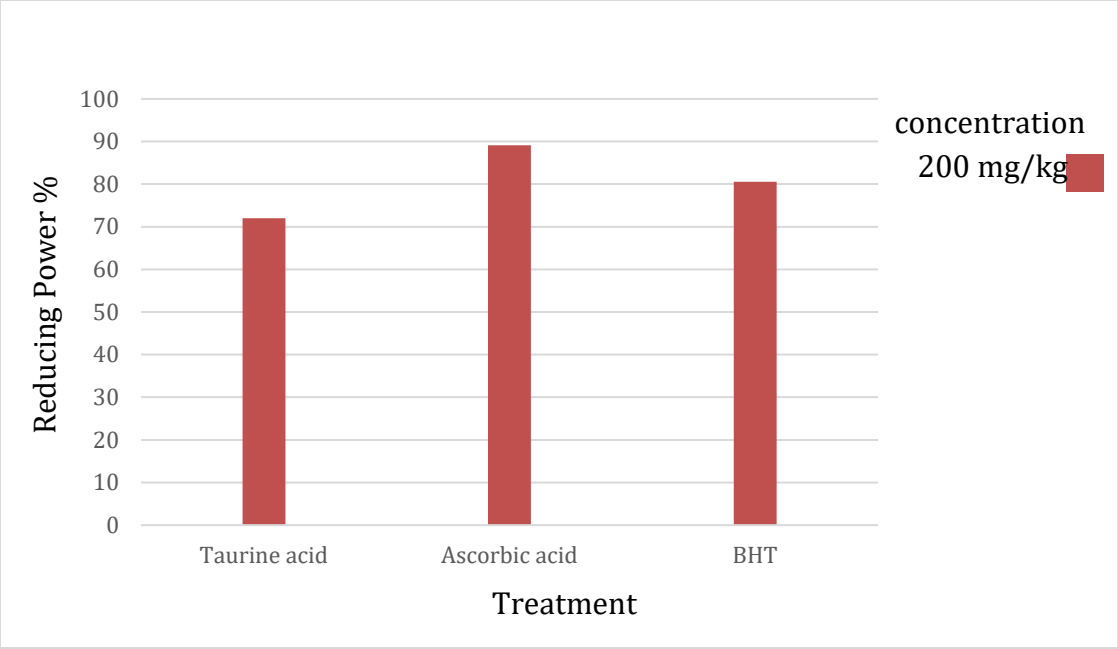


**Figure (3) Measurement of the reductive power of taurine acid RLSD = 8.54**

## Ferrous ion binding

The results in Figure 4 showed that taurine acid could bind ferrous ions that reached 82.61%, significantly superior ($P<0.05$) to the synthetic antioxidant BHT, which could bind ferrous ions that reached 73.45%, while the ability of ascorbic acid reached 89.83%. The reason for this may be that taurine contains amino acids that bind metals (17), as well as the ability of taurine acid to bind ferrous ions through redox (18).

## Conflicts of interest

The authors declare that there is no conflict of interest .

## Ethical Clearance

This work is approved by The Research Ethical Committee.

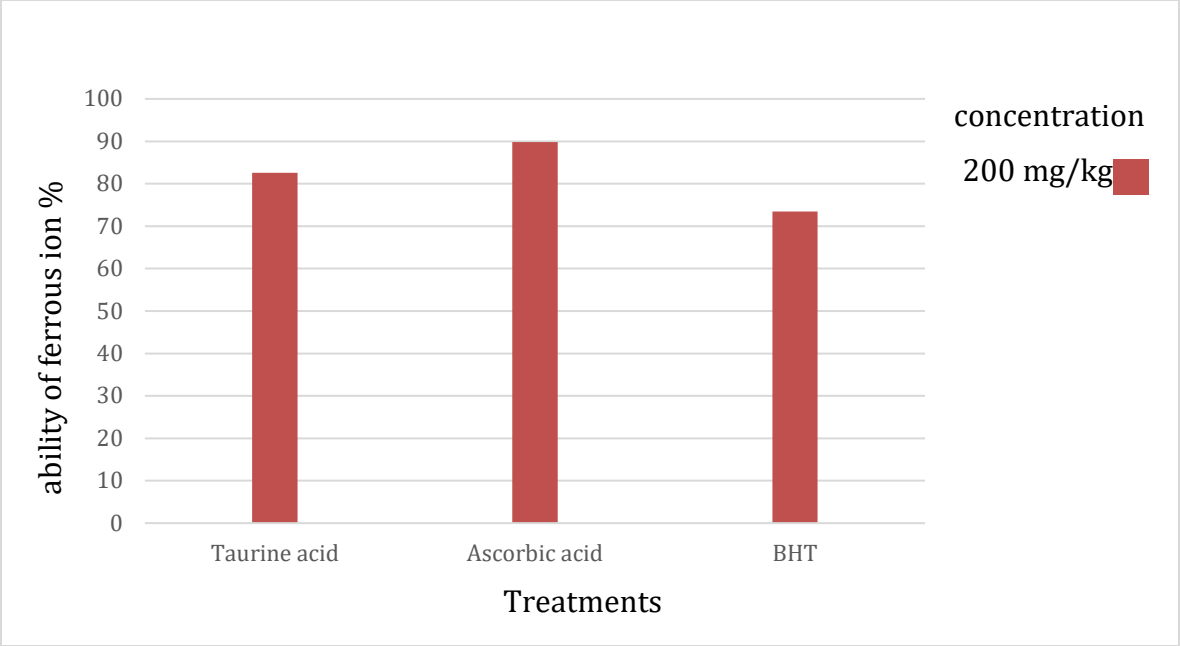


**Figure (4) The ability of taurine acid to bind ferrous ion RLSD = 7.21**

## References


1. Kıran, T. R., Otlu, O., & Karabulut, A. B. (2023). Oxidative stress and antioxidants in health and disease. *Journal of Laboratory Medicine, 47*(1), 1-11.
2. Jomova, K., Raptova, R., Alomar, S. Y., Alwasel, S. H., Nepovimova, E., Kuca, K., & Valko, M. (2023). Reactive oxygen species, toxicity, oxidative stress, and antioxidants: Chronic diseases and aging. *Archives of toxicology, 97*(10), 2499-2574.
3. Chaudhary, P., Janmeda, P., Docea, A. O., Yeskaliyeva, B., Abdull Razis, A. F., Modu, B., ... & Sharifi-Rad, J. (2023). Oxidative stress, free radicals and antioxidants: potential crosstalk in the pathophysiology of human diseases. *Frontiers in chemistry, 11*, 1158198.
4. Girish, Y. R., Sharath Kumar, K. S., Prashantha, K., Rangappa, S., & Sudhanva, M. S. (2023). Significance of antioxidants and methods to evaluate their potency. *Materials Chemistry Horizons, 2*(2), 93-112.
5. Al-Ameri, M. T., & Nasser, A. K. (2021). In vitro antioxidant properties of gum extract from the carob (Ceratonia silique L.) plant. *Basrah Journal of Agricultural Sciences, 34*(1), 83-92.
6. Baliou, S., Adamaki, M., Ioannou, P., Pappa, A., Panayiotidis, M. I., Spandidos, D. A., ... & Zoumpourlis, V. (2021). Protective role of taurine against oxidative stress. *Molecular medicine reports, 24*(2), 1-19.
7. Jakaria, M., Azam, S., Haque, M. E., Jo, S. H., Uddin, M. S., Kim, I. S., & Choi, D. K. (2019). Taurine and its analogs in neurological disorders: Focus on

therapeutic potential and molecular mechanisms. *Redox biology, 24*, 101223.
8. Song, Q., Guo, J., Zhang, Y., & Chen, W. (2021). The beneficial effects of taurine in alleviating fatty liver disease. *Journal of Functional Foods, 77,* 104351.
9. Mostafa, A. M., El Agouza, I. M., Hafez, H. F., & Banna, M. A. (2023). Assesment of serum taurine level as a potential biomarker for early diagnosis of diabetic nephropathy. *GSC Biological and Pharmaceutical Sciences, 22*(1), 312-320.
10. Khorasani Esmaeili, A., Mat Taha, R., Mohajer, S., & Banisalam, B. (2015). Antioxidant activity and total phenolic and flavonoid content of various solvent extracts from in vivo and in vitro grown Trifolium pratense L.(Red Clover). *BioMed Research International,(1*), 643285.
11. Prahadeesh, N., Sithambaresan, M., & Mathiventhan, U. (2018). A study on hydrogen peroxide scavenging activity and ferric reducing ability of simple coumarins. *Emerg. Sci. J, 2*(6), 417-427.
12. Mohsin, R. H., Nasser, A. K., & Al-Abadi, J. K. (2019). Effect of Quinoa Seeds on Enzymatic and Non-Enzymatic Antioxidants in Serum of Stressful Local Rabbits by Hydrogen Peroxide. *Journal of Al- Muthanna for Agricultural Sciences,7*(3).
13. Cheong, S. H., Moon, S. H., Lee, S. J., Kim, S. H., & Chang, K. J. (2013). Antioxidant and DNA protection effects of taurine by electron spin resonance spectroscopy. In Taurine 8: Volume 2: Nutrition and Metabolism, Protective Role, and Role in Reproduction, Development, and Differentiation (pp. 167-177). New York, NY: Springer New York.
14. Kim, J. H., Jang, H. J., Cho, W. Y., Yeon, S. J., & Lee, C. H. (2020). In vitro antioxidant actions of sulfur-containing amino acids. *Arabian Journal of chemistry, 13*(1),1687-1684.
15. Sikha, B. (2016). An assessment of antioxidant and anti-proliferative activities of super grain quinoa. *Journal of Food Processing and Technology, 7*(2):549.
16. Shabib, Alia Jari (2020). Use of carnosines extracted from camel meat and liver and quail meat in cold preservation of beef patties. Doctoral thesis, College of Agriculture, University of Basrah.
17. Wang, L.; Ma, M.; Yu, Z. and Du, S. K. (2021). Preparation an identification of antioxidant peptides from cottonseed proteins. *Food Chemistry,352*:1-9.
18. Seidel, U., Lüersen, K., Huebbe, P., & Rimbach, G. (2020). Taurine enhances iron-related proteins and reduces lipid peroxidation in differentiated C2C12 myotubes. *Antioxidants, 9*(11), 1071.

# تقدير فعالية حامض التورين كمضاد أكسدة خارج الجسم

زهراء عبد الستار عبد الرزاق و رغدان هاشم محسن

قسم الإنتاج الحيواني، كلية الزراعة, جامعة البصرة, البصرة , العراق.

## الخلاصة

أجريت هذه الدراسة في كلية الزراعة \قسم الإنتاج الحيواني \جامعة البصرة ,هدفت الدراسة الى أستخدام حامض التورين كمضاد أكسدة خارج الجسم وهو حامض أميني غير أساسي يحتوي على الكبريت صيغته الكيميائية $C_2H_7NO_3S$ يحتوي التورين على مجموعة السلفونات بدلاً من المجموعة الكربوكسيلية , تم قياس نشاط مضادات الأكسدة بأستخدام الكسح الجذري DPPH وقياس كسح بيروكسيد الهيدروجين والقدرة على ربط آيون الحديدوز وقياس القوة الأختزالية . أظهرت نتائج الدراسة وجود فروق معنوية ذات دلالة أحصائية في نشاط مضادات الأكسدة بأستخدام جذر DPPH لحامض التورين مقارنة بمضادات الأكسدة الصناعية وقدرة حامض التورين على أقتناص الجذور الحرة لبيروكسيد الهيدروجين وربط آيون الحديدوز , حيث بينت النتائج تفوقاً معنوي ($P<0.05$) على مضاد الأكسدة الصناعي BHT وأظهر التورين أيضاً قدرة عالية على القوة الأختزالية.

**الكلمات المفتاحية:** حامض التورين, مضادات اكسدة, DPPH.