

# Gastroprotective effect of Rhubarb powder (*Rheum rhabarbarum*) on rats with ethanol-induced gastric ulcer

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## Gastroprotective effect of Rhubarb powder (*Rheum rhabarbarum*) on rats with ethanol-induced gastric ulcer

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### Abstract

This study was performed to investigate the effect of the anti-inflammatory properties of Rhubarb powder against gastric mucosal damage induced by acute exposure to ethanol (5 ml/kg). Twenty five albino rats (*Sprague Dawley Strain*) weighing between 180-200g have been used for 4 weeks. They were divided into two main groups. The first group: Normal control group (negative group, 5 rats) fed on a basal diet for 4 weeks. The second group: Twenty rats were given a single oral dose of 5ml/kg of ethanol following overnight fasting to induce gastric lesions. After that, this group was divided into 4 groups, which were fed different diets (G2: Positive control group, G3: A standard control group, G4: 5% Rhubarb powder and G5: 10% Rhubarb powder). Chemical, biochemical analysis (in serum and gastric mucosa) and histological tests were carried out. These results showed that Rhubarb powder contains a high amount of carbohydrate, ash and protein and contains a moderate amount of fat and fiber. GSH, SOD, GST and CAT serum increased significantly in all groups that were supported by different percentages of Rhubarb powder compared to the positive control group, while MPO serum decreased significantly in all groups that were supported by different percentages of Rhubarb powder compared with the positive control group. Additionally, they showed a significant increase in NO, SOD, GPX and GSH in gastric mucosa in all groups that were supported by different percentages of

Rhubarb powder in comparison with the positive control group. However, MDA in mucosa decreased significantly in all groups that were supported by different percentages of Rhubarb powder compared to the positive control group. Regarding the histopathological examination of the stomach, there was a remarkable improvement in all groups whose diets were supported by different percentages of Rhubarb powder compared to the positive control group. Consequently, this study recommends using Rhubarb powder for improving oxidative stress and inflammatory responses because of its bioactive properties.

**Key words:** Rhubarb powder - gastric ulcer - gastric biochemical parameters - oxidative stress markers - inflammatory parameters.

### **Introduction**

Rhubarb is a collective name for various perennial plants of the genus *Rheum* from the Polygonaceae family. It contains major active substances such as anthraquinones, anthrones, stilbenes, tannins, polysaccharides (Cao *et al.*, 2017), phenolic acid, sennoside (Xiong *et al.*, 2019), dianthrones, anthocyanins, flavonoids, polyphenols, organic acids, and chromones (Wang *et al.*, 2009). Rhubarb also contains a high amount of minerals, esp. potassium and magnesium, whereas calcium is not present due to precipitation with oxalic acid and it contains high concentrations of nitrate (Will & Dietrich, 2013). These compositions show extensive pharmacological activities including regulating gastrointestinal, anticancer, antimicrobial, hepatoprotective, anti-inflammatory, protecting cardiovascular, cerebrovascular (Cao *et al.*, 2017), antitumor activity, nephric protection and chronic renal failure (Wang *et al.*, 2009).

**Luo et al., (2019)** demonstrated that Rhubarb has beneficial effects on ulcerative colitis mice. Its mechanism is associated with regulating the gut microbiota and short chain fatty acids, restoring homeostasis and diversity, reducing the proportion of Th17 cells and elevation the percentage of Treg cells, as well as regulating their respective cytokine levels. At the same time, Rhubarb treatment effectively improved oxidative stress and inflammatory responses (**Wang et al., 2020**).

Gastric ulcer is the most common stomach disease that is often accompanied by inflammation, congestion, edema, scar tissue formation, and pyloric obstruction (**Liu et al., 2021**). It occurs due to alcohol consumption, physiological stress, smoking, hydrochloric acid, ischemia, NSAID (Non-steroidal anti-inflammatory drugs) medications, hypoxia and Helicobacter pylori infection (**Rahman et al., 2020**). It is a defect in the mucosal barrier of the stomach lining that penetrates through the muscularis mucosa and it is greater than 5 mm in diameter (**Woolf, & Rose, 2019**). Ethanol-induced Gastric ulcer in animal models resembles the pathophysiology of human ulcer (**Rahman et al., 2020**). This study was carried out to investigate the effect of using Rhubarb powder against gastric mucosal damage induced by acute exposure to ethanol (5 ml/kg).

## Materials and Methods

### Materials

- Dried samples of Rhubarb (*Rheum rhabarbarum*) were obtained from National Research Center in Dokki, (Cairo, Egypt).
- Casein, vitamins, minerals, cellulose, choline chloride and Ethanol (99.75%) were purchased from El-Gomhoreya Company, Cairo, Egypt.

- Omeprazole was purchased from a government al approved pharmaceutical company in Cairo, Egypt.
- Oil and starch were purchased from a local market, Cairo, Egypt.
- Twenty five albino rats (*Sprague Dawley Strain*) weighing between 180-200g were obtained from Food Technology Research Institute, Giza.

## Methods:

### Phytochemical screening

To determine the major chemical constituents (glycosides, alkaloids, tannins, saponins, terpenoids, carbohydrates, cardiac glycosides, anthraquinones glycosides, flavonoids, and phenols) present in the plant, the qualitative phytochemical screening of the plant was carried out using the colour reactions. **Selim *et al.*, (2020)**.

### Chemical analysis

Chemical analysis of the dried Rhubarb powder including protein, lipids, moisture and ash were conducted at Food Technology Research Institute according to the method described by the **A.O.A.C., (2005)**. Carbohydrate value was calculated according to **FAO (1982)** as follows:

Soluble carbohydrates (%) = 100 – (protein % + ash % + fat % + fiber % + moisture %).

### Biological Experiment

Diet was given in non-scattering feed cups to minimize food loss. Water was provided to the rats by means of a glass tube projecting through the cage wire. The ingredients (100 g) of the basal diet

were prepared according to **Reeves et al., (1993)** in the animal house of the Agricultural Research Center in the Ministry of Agriculture, Giza.

The basal diet consisted of casein 12%, cellulose 5%, corn oil 10%, mineral mixture 4%, vitamin mixture 1%, choline chloride 0.20% and the remained amount is starch added according to **AIN's method, (1993)**. After the adaptation period, the experimental animals were divided into two main groups. The first group: Normal control group (negative group, 5 rats) in which, rats were fed on a basal diet for 4 weeks. The second group: Twenty rats were given a single oral dose of 5ml/kg of ethanol following overnight fasting to induce gastric lesions according to **Tolulope et al., (2019)**. After that, this group was divided into 4 groups (5 rats per each) as follows:

**Group 2:** Positive control group (non-treated group) fed on basal diet.

**Group 3:** A standard control group was orally given 20 ml/kg body weight of omeprazole according to **Rahman et al., (2020)**. Omeprazole is a preventive treatment for Gastric ulcers. Additionally, fed on the basal diet

**Group 4:** Rats fed on an experimental diet containing 5% Rhubarb powder

**Group 5:** Rats fed on an experimental diet containing 10% Rhubarb powder

During the experimental period (4 weeks), each rat was weighed every week and food consumption was recorded. The body weight gain and food efficiency ratio (FER) were determined according to **Chapman et al., (1959)** using the following formula:

$$(BWG) = \frac{\text{Final Weight} - \text{Initial Weight}}{\text{Initial Weight}}$$

$$(FER) = \frac{\text{Daily body Weight gain(g)}}{\text{Food intake (g/d)}} * 100$$

At the end of the experimental period, rats were fasted overnight before slaughtering. After that, the blood was collected and then centrifuged. Serum was separated and stored at -20°C for biochemical analysis (oxidative stress markers and inflammatory parameters) i.e. Glutathione (GSH) was analyzed using ELISA Kit (catalog No.CSB-E12144r), Superoxide dismutase (SOD) was analyzed using ELISA Kit (catalog NO.CSB-E08555r), Glutathion-s-Transferase (GST) was analyzed using ELISA Kit (catalog NO.MBS2604486), Catalase (CAT) was analyzed using ELISA Kit (catalog NO.MBS2600683) and Myeloperoxidase (MPO) was analyzed using ELISA Kit (catalog NO.CSM-E08722r). Also the gastric mucosal was collected and stored at -20°C for biochemical analysis (gastric biochemical parameters) i.e Malondialdehyde (MDA) was analyzed using ELISA Kit (catalog NO.MBS2636626), Glutathione peroxidase (GPX) was analyzed using ELISA Kit (catalog NO.MBS744364), Glutathione (GSH) was analyzed using ELISA Kit (catalog No.CSB-E12144r), Superoxide dismutase (SOD) was analyzed using ELISA Kit (catalog NO.CSB-E08555r) and Nitric Oxide (NO) was analyzed using ELISA Kit (catalog NO.MBS723386).

### **Histopathological Examination**

The stomach was separated from each rat, photoed (Table 1) and then examined histopathologically according to **Bancroft *et al.*, (2012)**.

### **Statistical analysis**

Results are expressed as mean  $\pm$  SD. Data were statistically analyzed using one – way analysis of variance "ANOVA" according to **McClave & Benson, (1991)**.

## **Results and Discussion**

### **Phytochemical screening**

The qualitative phytochemical screening of *Rheum rhabarbarum* revealed that tannins (++++), Steroids (++++), terpenoids (+++), flavonoids (+++), saponines (++) , and alkaloids (+) **Selim et al., (2020)**.

### **Chemical composition of Rhubarb powder**

The crude fiber, moisture, ash, fat, protein and carbohydrates content of Rhubarb powder are shown in Table 2. The amounts of carbohydrates, crude protein, fat content, crude fiber, ash and moisture in the Rhubarb powder were 74.12, 7.36, 4.19, 3.87, 7.41 and 3.05 % on dry weight, respectively. These results showed that Rhubarb powder contains a high amount of carbohydrate, ash and protein, and contains a moderate amount of fat and fiber. Similar results were obtained by **Orlygsson & Scully (2021)** who demonstrated that Rhubarb includes 75.87 % carbohydrates, 10.07 % protein, 3.29 % fat and 10.78 ash on a dry weight basis.

### **Initial weight, final weight, feed intake (FI), feed efficiency ratio (FER) and body weight gain (BWG) of rats fed on different experimental diets**

The initial weight, final weight, feed intake (FI), body weight gain (BWG) and feed efficiency ratio (FER) of all tested diets are presented in Table 3. After feeding, the BWG of the rats fed on different tested diets



for 4 weeks was calculated and it ranged from 0.04 to 0.38g whereas there are no significant differences in values of food intake in all tested groups compared to the positive control. As for the feed efficiency ratio (FER), it ranged from 1.43 to 13.28 %. The highest value of FER was for G1 followed by G2 then G3, G4 and G5.

Regarding the initial weight, there are no significant differences in values in all tested groups but there is a significant increase in the final weight values between all tested groups. The highest value was G1 followed by G2, G3, G4 and G5. These differences may be attributed to rhubarb's high content of protein. Similar results were obtained by **Xia et al., (2001)** who confirmed that the body weight of the groups that were given different proportions of rhubarb was reduced on the 4th day. These results suggest that the effect of rhubarb on weight loss is mainly due to its direct action on peripheral sites.

### **Evaluation of oxidative stress markers and inflammatory parameters in serum**

Evaluation of oxidative stress markers and inflammatory parameters in serum are Glutathione (GSH), Superoxide dismutase (SOD), Glutathione-s-Transferase (GST), Catalase (CAT) & Myeloperoxidase (MPO). As shown in Table 4, the ethanol treatment reduced the GSH, SOD, GST and CAT serum compared to the negative control group. However, a significant increase was observed in GSH, SOD, GST and CAT of rats given Rhubarb powder compared to G2 and the best results were for G5 that was given 10% Rhubarb powder. A significant increase was also observed in GSH, SOD, GST and CAT in G3 compared to G2 and G4. Whereas the ethanol treatment increased the MPO serum compared to the negative control group. At the same time,

the results showed a significant decrease of MPO of rats given Rhubarb powder in comparison with G2 and the best results were for G5 that was given 10% Rhubarb powder. A significant decrease was also observed in MPO in G3 compared to G2 and G4. These findings are supported by the results of **Liang *et al.*, (2021)** who demonstrated that Rhubarb increased SOD activity by 270.96 and 962.19% & CAT activity by 54.61 and 149.34%. SOD and CAT are important enzymes involved in the elimination of reactive oxygen species in organisms. Similar results were obtained by **Zhou *et al.*, (2016)** who deduced that rhubarb improved gastrointestinal function and inhibition of systemic inflammation. This review of recent studies intends to investigate relationships between tannins' chemical makeup and their ability to prevent stomach ulcers. Tannins are largely employed in medicine for their astringent effects. These characteristics result from tannins' interactions with the tissue proteins they come into touch with. This protein-tannin complex layer shields the stomach from damage or irritation caused by chemicals and mechanical forces in cases of gastric ulcers **Orlygsson, & Scully, (2021)**. It is well known that high content of steroids, terpenoids and flavonoids also showed anti-ulcer and antiinflammatory activities and most of the flavonoids are strong antioxidants **Sattar, *et al.*, (2019)**.

### **Evaluation of gastric biochemical parameters**

Evaluation of gastric biochemical parameters, Nitric Oxide (NO), Superoxide dismutase (SOD), Glutathione peroxidase (GPX), Glutathione (GSH) & Malondialdehyde (MDA) of all tested groups are shown in Table 5. The results of NO, SOD, GPX and GSH recorded a significant decrease in the positive control group in comparison with the negative control group due to the significant injury to the gastric mucosa. However, a significant increase was observed in NO, SOD, GPX and

GSH of rats given Rhubarb powder compared to G2 and G3 and the best results were for G5 was given 10% Rhubarb powder. Whereas the results of MDA showed a significant increase in the positive control group when compared to the negative control group due to the significant injury to the gastric mucosa. Nevertheless, the results showed a significant decrease in MDA of rats given Rhubarb powder in comparison with G2 and G3 and the best results were of G5 that was given 10% Rhubarb powder. Similar results were obtained by **CAO *et al.*, (n.d)** who pointed out that the Rheum significantly decreased the ulcer index and the level of MDA in the mucosa of stressed rats, and increased the activity of SOD both in serum and gastric mucosa and it also has remarkable protective effects on induced gastric ulcer in rats.


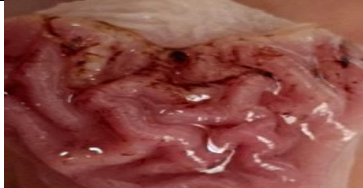



### **Histopathological examination of stomach**

Microscopically, the G1 rat's stomach revealed the normal histological structure of gastric layers (Figs. 1 & 2). In contrast, the G2 rat's stomach showed remarkable histopathological alterations characterized by focal necrosis of gastric mucosa, mucosal inflammatory cells infiltration, submucosal edema associated with inflammatory cells infiltration (Figs. 3 & 4). Otherwise, a marked ameliorative effect was noticed in the gastric tissue of rats from the rest groups 3, 4 & 5. The examined sections from G 3 exhibited no histopathological alterations (Fig. 5) except congestion of mucosal and submucosal blood vessel (Fig. 6) in some examined sections. Furthermore, some stomach sections of rats from G 4 & 5 appeared with normal histological structure (Figs. 8, 9 & 10) whereas the other sections from those groups revealed slight submucosal edema (Fig.7). These results confirm blood analysis of experimental rats.

## Conclusion

Rhubarb is an important natural herb. Its powder helps in healing ethanol-induced gastric ulcers in rats. Therefore, it is considered a therapeutic alternative in the treatment of gastric ulcers. However, based on the previous studies, rhubarb is not suitable for long-term use to avoid its toxic side effects

**Table 1: photos illustrating rat stomach before the histopathological examination**

Groups	Organs	Photo of Stomach
G1 Control (-ve)		
G2 Control (+ve)		
G3		
G4		
G5		

**G1:** Negative control group, **G2** Positive control, **G3:** 20 ml/kg body weight of omeprazole, **G4:** 5% Rhubarb powder, **G5:** 10% Rhubarb powder

**Table 2: Chemical composition of Rhubarb powder (dry basis)**

Samples name	Test results (%)					
	Fiber	Moisture	Ash	Fat	Protein	Carbohydrate
Rhubarb powder	3.87	3.05	7.41	4.19	7.36	74.12

**Table 3: Initial weight, final weight, feed intake (FI), feed efficiency ratio (FER) & body weight gain (BWG) of rats fed on different experimental diets**

Groups Parameter	Negative Control (G1) (Mean±S.D)	Positive Control (G2) (Mean±S.D)	Omeprazole (G3) (Mean±S.D)	Rhubarb powder Treatments (Mean±S.D)		LSD 0.05
				5%(G4)	10 % (G5)	
Initial weight (g)	191.2 <sup>a</sup> ± 10.26	191 <sup>a</sup> ± 10.25	196 <sup>a</sup> ± 8.94	192.2 <sup>a</sup> ± 8.50	188.6 <sup>a</sup> ± 10.48	12.82
Final weight (g)	264 <sup>a</sup> ± 23.16	245.6 <sup>ab</sup> ± 21.50	229.2 <sup>bc</sup> ± 15.71	206.8 <sup>cd</sup> ± 12.03	195.8 <sup>d</sup> ± 13.08	23.31
FI (g/d)	18.8 <sup>a</sup> ± 0.45	18.6 <sup>a</sup> ± 0.55	18.6 <sup>a</sup> ± 0.55	18.6 <sup>a</sup> ± 0.55	18.4 <sup>a</sup> ± 0.55	0.70
BWG (g)	0.38 <sup>a</sup> ± 0.07	0.29 <sup>b</sup> ± 0.07	0.17 <sup>c</sup> ± 0.07	0.08 <sup>d</sup> ± 0.05	0.04 <sup>d</sup> ± 0.01	0.08
FER (%)	13.28 <sup>a</sup> ± 3.16	10.54 <sup>a</sup> ± 3.04	6.41 <sup>b</sup> ± 3.05	2.77 <sup>c</sup> ± 1.84	1.43 <sup>c</sup> ± 0.70	3.36

(FI) feed intake, (BWG) body weight gain and (FER) feed efficiency ratio

**Table 4: Evaluation of oxidative stress markers and inflammatory parameters in serum**

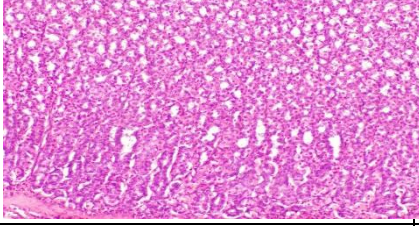
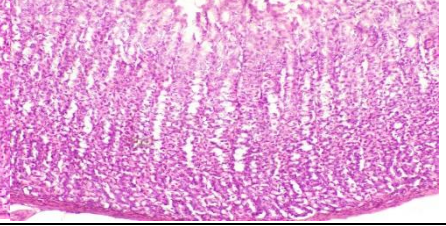
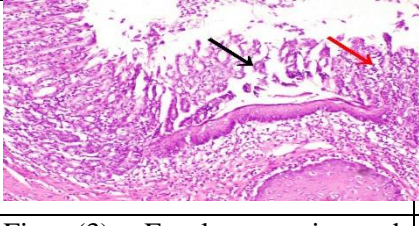
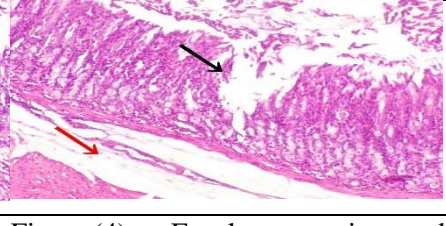
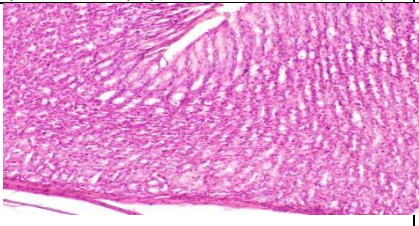
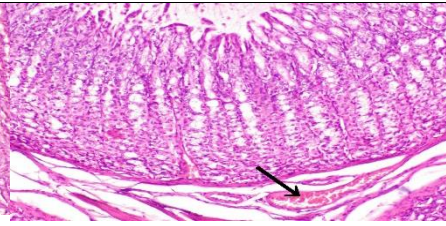
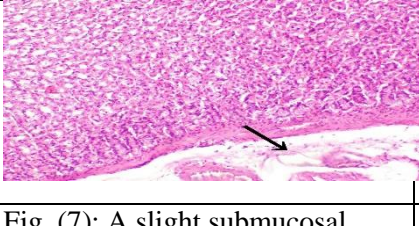
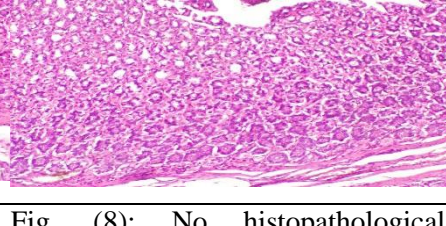
Groups Parameter	Negative Control (G1) (Mean±S.D)	Positive Control (G2) (Mean±S.D)	Omeprazole (G3) (Mean±S.D)	Rhubarb powder Treatments (Mean±S.D)		LSD 0.05
				5%(G4)	10 % (G5)	
GSH (ng-mg)	86.28 <sup>d</sup> ± 7.19	38.30 <sup>e</sup> ± 7.93	145.7 <sup>b</sup> ± 4.20	112.27 <sup>c</sup> ± 9.20	193.03 <sup>a</sup> ± 4.05	12.43
SOD (U-mg)	89.80 <sup>d</sup> ± 5.27	41.5 <sup>e</sup> ± 10.69	161.3 <sup>b</sup> ± 4.95	130.4 <sup>c</sup> ± 6.80	197.47 <sup>a</sup> ± 6.20	12.90
GST (ng-mg)	5.84 <sup>b</sup> ± 1.05	0.35 <sup>d</sup> ± 0.07	5.31 <sup>b</sup> ± 0.89	2.81 <sup>c</sup> ± 0.61	9.57 <sup>a</sup> ± 0.85	1.41
CAT (ng-mg)	7.92 <sup>b</sup> ± 1.10	0.45 <sup>c</sup> ± 0.07	7.27 <sup>b</sup> ± 1.25	5.78 <sup>b</sup> ± 1.47	12.53 <sup>a</sup> ± 0.82	1.93
MPO (ng-mg)	2.62 <sup>bc</sup> ± 0.56	12.47 <sup>a</sup> ± 0.95	1.65 <sup>c</sup> ± 0.51	3.16 <sup>b</sup> ± 0.36	0.54 <sup>d</sup> ± 0.24	1.05

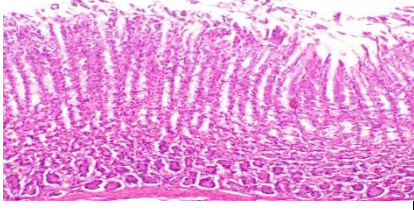
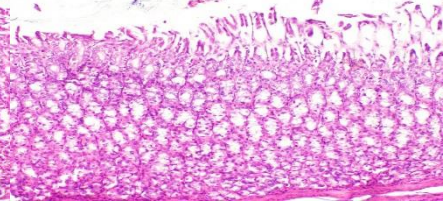
Glutathione (GSH), Superoxide dismutase (SOD), Glutathion-s-Transferase (GST), Catalase (CAT) & Myeloperoxidase (MPO)

**Table 5: Evaluation of gastric biochemical parameters**

Groups Parameter	Negative Control (G1) (Mean±S.D)	Positive Control (G2) (Mean±S.D)	Omeprazole (G3) (Mean±S.D)	Rhubarb powder Treatments (Mean±S.D)		LSD 0.05
				5%(G4)	10 % (G5)	
NO (umol-L)	34 <sup>b</sup> ± 4.31	1.88 <sup>d</sup> ± 0.35	21.05 <sup>c</sup> ± 3.53	34.64 <sup>b</sup> ± 3.43	54.48 <sup>a</sup> ± 4.17	6.32
SOD (U-ml)	74.62 <sup>b</sup> ± 2.46	17.15 <sup>d</sup> ± 5.53	57.32 <sup>c</sup> ± 3.90	78.12 <sup>b</sup> ± 3.03	147.73 <sup>a</sup> ± 3.60	7.00

<b>GPX</b> (U-ml)	53.24 <sup>d</sup> ± 2.92	24.25 <sup>e</sup> ± 3.70	68.13 <sup>e</sup> ± 4.07	134.63 <sup>b</sup> ± 6.50	167.6 <sup>a</sup> ± 6.06	8.83
<b>GSH</b> (ng-ml)	77.15 <sup>d</sup> ± 7.07	35.91 <sup>e</sup> ± 5.84	98.14 <sup>e</sup> ± 3.10	133.07 <sup>b</sup> ± 3.90	155.27 <sup>a</sup> ± 5.90	9.75
<b>MDA</b> (nmol-ml)	3.34 <sup>b</sup> ± 0.97	15.25 <sup>a</sup> ± 2.84	3.82 <sup>b</sup> ± 1.61	1.92 <sup>b</sup> ± 0.92	0.84 <sup>b</sup> ± 0.11	2.87
Nitric Oxide (NO), Superoxide dismutase (SOD), Glutathione peroxidase (GPX), Glutathione (GSH) & Malondialdehyde (MDA)						

Organs Groups	Photomicrograph of Stomach	
G1 Control (-ve)		
	Fig. (1): The normal histological structure of gastric layers (H & E stain, X 100).	Fig. (2): The normal histological structure of gastric layers (H & E stain, X 100).
G2 Control (+ve)		
	Fig. (3): Focal necrosis and sloughing of gastric mucosa (black arrow) associated with inflammatory cells infiltration (red arrow) (H & E stain, X 100).	Fig. (4): Focal necrosis and sloughing of gastric mucosa (black arrow) and submucosal edema (red arrow) (H & E stain, X 100).
G3		
	Fig. (5): No histopathological alterations (H & E stain, X 100).	Fig. (6): Congestion of submucosal blood vessel (arrow) (H & E stain, X 100).
G4		
	Fig. (7): A slight submucosal edema (arrow) (H & E stain, X 100).	Fig. (8): No histopathological alterations (H & E stain, X 100).

G5		
	Fig. (9): Apparent normal histological structure (H & E stain, X 100).	Fig. (10): No histopathological alterations (H & E stain, X 100).

**G1:** Negative control group, **G2** Positive control, **G3:** 20 ml/kg body weight of omeprazole, **G4:** 5% Rhubarb powder, **G5:** 10% Rhubarb powder

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## التأثير المعدي لمسحوق الراوند على الجرذان المصابة بقرحة المعدة المستحدثة بالإيثانول

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### الملخص العربي

أجريت هذه الدراسة لمعرفة تأثير الخواص المضادة للالتهابات لمسحوق الراوند ضد تلف الغشاء المخاطي المعدي (قرحة المعدة) الناجم عن التعرض الحاد للإيثانول (5 مل / كجم). تم استخدام خمسة وعشرين من جرذان الألبينو (سلالة سبراج داولي) تزن ما بين 180-200 جم لمدة 4 أسابيع تم تقسيمهم إلى مجموعتين رئيسيتين. المجموعة الأولى: المجموعة الضابطة (المجموعة السالبة، 5 جرذان) تتغذى على الوجبة الأساسية لمدة 4 أسابيع. المجموعة الثانية: عشرون جرذا أعطيت جرعة واحدة عن طريق الفم مقدارها 5 مل / كجم من الإيثانول بعد الصيام طوال الليل لتحفيز الإصابة بالقرحة المعديّة. بعد ذلك تم تقسيم هذه المجموعة إلى 4 مجموعات تم تغذيتها على وجبات غذائية مختلفة (G2: مجموعة التحكم الإيجابية، G3: مجموعة التحكم القياسية، G4: 5% مسحوق راوند و G5: 10% مسحوق راوند). تم إجراء التحاليل الكيميائية والبيوكيميائية (في السائل المخاطي للمعدة وفي مصل الدم) والهستوباثولوجية. أظهرت هذه النتائج أن مسحوق الراوند يحتوي على نسبة عالية من الكربوهيدرات والرماد والبروتين وكمية معتدلة من الدهون والألياف. زاد مصل GSH و SOD و GST و CAT بشكل ملحوظ في جميع المجموعات التي تم تدعيمها بنسب مختلفة من مسحوق الراوند مقارنة بمجموعة التحكم الإيجابية، بينما انخفض مصل MPO بشكل ملحوظ في جميع المجموعات المدعمة بنسب مختلفة من مسحوق الراوند مقارنة مع مجموعة التحكم الإيجابية. بالإضافة إلى ذلك، أظهرت الدراسة زيادة معنوية في NO و SOD و GPX و GSH في السائل المخاطي للمعدة في جميع المجموعات التي تم تدعيمها بنسب مختلفة من مسحوق الراوند مقارنة مع مجموعة التحكم الإيجابية. ومع ذلك، انخفض MDA في السائل المخاطي بشكل ملحوظ في جميع المجموعات التي تم تدعيمها بنسب مختلفة من مسحوق الراوند مقارنة مع مجموعة التحكم الإيجابية. فيما يتعلق بالفحص الهستوباثولوجي للمعدة، كان هناك تحسن ملحوظ في جميع المجموعات التي تم تدعيمها بنسب مختلفة من مسحوق الراوند مقارنة بمجموعة التحكم

الإيجابية. وبالتالي، توصي هذه الدراسة باستخدام مسحوق الراوند لتحسين الإجهاد التأكسدي والاستجابات الالتهابية وذلك لما له من خصائص نشطة بيولوجيًا.

**الكلمات الدالة:** مسحوق الراوند - قرحة المعدة - التحاليل البيوكيميائية للسائل المعدي - الإجهاد التأكسدي - المعلمات الالتهابية.