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Gastroprotective effect of Iraqi dates Palm (*Phoenix dactylifera* L. Cv. Barhi) dates and seeds extracts on ethanol-induced gastric ulcer in rats

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Abstract

Objective: The goal is to find effective treatments for gastric ulcers with minimal side effects. We used ethanol-induced gastric ulcer models in rats to examine the gastro-protective benefits of Iraqi dates palm (*Phoenix dactylifera* L. Cv. " Barhi ") Methods: Six groups of seven rats each were formed from 42 rats. Groups 1 (normal control) and 2 (negative control) were given 10 ml/kg of distilled water; group 3 (positive control) was given famotidine (20 mg/kg); groups 4 date palm fruit extract were given (8 ml/kg); groups 5 date palm seed extract were given (8 ml/kg); and groups 6 mixture of date palm fruit extract and date palm seed extract were given (8 ml/kg). On day 15, rats in all groups (except the normal control group) received an oral administration of 99.8% ethanol (5 ml/kg) to cause an acute ulcer. All animals were slaughtered after 1 hour, and their stomachs were removed for further analysis. Results: Date fruit, date seed, and a combination of aqueous extracts were efficient in reducing the severity of gastric ulceration and protecting against ethanol's negative effects on gastrin, glutathione, and gastric mucus. Conclusion: Date extracts have been hypothesized to have a gastroprotective effect due to their potential anti-oxidant properties.

Keywords: Famotidine, gastrin, glutathione

Introduction

One of the most prevalent gastrointestinal conditions, with a high frequency worldwide, is peptic ulcer (PU) disease (Aihara et al., 2003). which annually affects 4 million individuals with a high rate of complications associated with co-morbidity and mortality (Zelickson et al., 2011). Gastric pepsin and hyperacidity disrupt duodenal and gastric mucosa, leading to mucosal injury and complicated perforation (Ramakrishnan & Salinas, 2007). An imbalance between aggressive and defensive elements underlies the fundamental pathophysiology of stomach ulcers. Excessive hydrochloric acid and pepsin production, refluxed bile, leukotrienes, stress, and reactive oxygen species (ROS) are just some of the endogenous hostile forces constantly putting the gastric mucosa to the test (S. J. Konturek et al., 2004). There is an unambiguous relationship between etiologic factors like Helicobacter pylori infection, non-steroidal anti-inflammatory medication (NSAID), alcohol, tobacco, and PU (Behrman, 2005; A. A. Jaccob et al., 2021). Previous studies have reported that alcohol and NSAIDs are the most frequently utilized substances worldwide, causing gastrointestinal problems (Riezzo et al., 2001).

According to the World Health Organization, alcohol contributed to digestive system diseases in over 3 million fatalities in 2016 (more than two million male fatalities and seven million female deaths). Animal studies showed that ethanol quickly got into the gastric mucosa, where it caused lesions like increased submucosal edema, mucosal disintegration, long hemorrhagic bands, and a drop in the production of gastric mucosal protective factors (Saeed AL-Wajeeh et al., 2016). Gastric mucosa ulceration due to ethanol-induced oxidative stress is widely documented, and the free radicals it produces are known to be very cytotoxic (Wu et al., 2018). In gastric ulcers (GU), free radicals play a significant role in the pathophysiological alterations by inducing oxidative damage to gastric mucosal cells. However, ethanol increases gastric mucosal cell susceptibility to free radical damage by disrupting gastric secretory function, modifying cell permeability, and decreasing gastric mucus (Sistani Karampour et al., 2019). Absolute ethanol raises reactive oxygen species, proinflammatory factors, and lipid marker peroxidation when given orally to rats, which also lowers prostaglandin E2 and causes bleeding in the stomach mucosa (Liu et al., 2020).

Most anti-ulcer medications now used to treat peptic ulcers, including proton pump inhibitors, antacids, and antihistaminic therapies, demonstrate minimal effectiveness and undesirable side effects (DeVault & Talley, 2009). Additionally, herbal medications have been found to have fewer side effects compared to traditional antiulcer drugs. These natural remedies are gaining popularity as they provide a promising alternative or additive effect for individuals seeking a more holistic approach to treating ulcers without compromising effectiveness or safety (Kangwan et al., 2014).

In traditional medicine, the date palm (Phoenix dactylifera L.), DP, is valued for its possible health advantages (Orabi & Shawky, 2014). It is grown in the eastern Mediterranean region and northern Africa, where the climate is hot and dry (Al-Alawi et al., 2017). About 650 of the roughly 5,000 date palm varieties prevalent across the globe may be found in Iraq (Ibrahim, 2008). Iraq and other Middle Eastern nations rely heavily on the harvest of the DP. These nations have over 60 million date palms, making them ideal locations for growing this crop (Zaid, 2010).

(Phoenix dactylifera L. Cv. "Barhi"), IDP.B, the name of Barhi, referring to maturity affected by summer winds at Basrah, is one of the types of DP that is widely grown and consumed in Iraq; it is crisp, delicious, and has a brilliant yellow look in the Bisr stage (Arabic words for the various phases of date fruit growth: Hababouk, Kimri, Bisr, Rutab, and Tamer) (Faisal et al., 2020; Ghnimi et al., 2017).

DP is a good source of several nutrients, including carbohydrates, fiber, glucose, protein, amino acids such us (Aspartic acid, Cysteine, Alanine, Arginine, Glutamic acid), vitamins such us (group B vitamins, beta-carotene vitamin A, low vitamin C) minerals such us (Potassium, Phosphorous, Calcium, Magnesium) tannins, carotenoids and antioxidant components such as polyphenols. One of the plants' most common secondary metabolites is polyphenolic chemicals, primarily phenolic acids and flavonoids. The date fruit may be a more vibrant source of these chemicals than other fruits (Al-Alawi et al., 2017; M. A. Al-Farsi & Lee, 2008; Fernández-López et al., 2022). They aid in digestive health due to their high polyphenol and applicable fiber content (M. Al-Farsi et al., 2005). Antimutagenic, anticarcinogenic, anti-inflammatory, and antioxidant benefits are only some of the many positive biological effects associated with polyphenols. They are crucial in preventing oxidative damage to food systems, human cells, and tissues caused by free radicals. Free radicals have been linked

to numerous diseases, including cancer, heart disease, Parkinson's disease, and Alzheimer's disease (Maqsood et al., 2020).

Several studies have investigated the effectiveness of DP, which has been found to exhibit antioxidant properties by scavenging free radicals and inhibiting iron-induced lipid peroxidation (Chaira et al., 2009). Additionally, DP has been found to have anti-viral properties by preventing Pseudomonas phage from exerting its lytic activity on Pseudomonas aeruginosa, ATCC 14209-B1 (Jassim & Naji, 2010). DP also has antihyperlipidemic properties, as it can reduce plasma triglyceride and cholesterol levels (Al-Yahya et al., 2016). Moreover, DP has a nephroprotective effect, as it can prevent gentamicin-induced renal damage and lower creatinine and urea levels (Al-Qarawi et al., 2008). Furthermore, dates have been identified as a potential antiulcer agent due to their fruits and seeds' potent anti-inflammatory and antioxidant effects.

This study aimed to determine whether Iraqi date palms (Phoenix dactylifera L. Cv. "Barhi") IDP.B could shield rats' stomachs from ethanol damage.

Materials and methods

Plant material

IDP.B was purchased from a local vendor at the Abu-Alkaseb facility in Basrah, Iraq, and was confirmed as genuine by a botanist at the University of Basrah. The fruit was hand-separated from the seed, sliced into tiny pieces, and immersed in distilled water at 4°C for 48 hours (1:3, weight to volume). The seeds were collected after the fruit was rinsed off and then dried at room temperature. After being dried, the seeds were crushed into a fine powder and soaked in a 1:3 weight/volume ratio of cold distilled water for 48 hours at 4 degrees Celsius and centrifuged daily in the morning, and supernatant given in gavage to rats.

Qualitative phytochemical analysis

Alkaline reagent test for flavonoid: The extracted sample is treated with 2 ml of a 2% NaOH solution, and then two drops of diluted HCL are added.

Ferric chloride test for phenolic and tannin: 2% FeCl3 was added with 2 ml of extract for phenolic, and 1 ml of 3% FeCl3 was added for tannin.

Animals

In this study, 42 mature female albino rats weighing 150–220 g were employed. The animals came from Basrah's College of Veterinary Medicine. All three rats were caged in plastic. The animals were housed in a temperature- and humidity-controlled environment with sunlight exposure around "12 h light/12 h dark," often maintaining a temperature of 23°C ± 2°C. They were given a standard pelletized feed and access to water 24 hours a day, and their weight was recorded during the work at 1st, 7th, and the end of the experiment.

Stomach ulcer induction

Oral gavage administration of 5 ml/kg (99.8% absolute) ethanol was sufficient to produce GU in rats (Simões et al., 2019).

Experimental design

After adaptation, rats were randomized into six groups. Treated for 14 days according to the following:

Group 1 (control) and Group 2 (the negative control): received normal saline (10 ml/kg). Group 3 (positive control): Famotidine (20mg/kg) (Karaoğlan et al., 2018). Group 4 aqueous date palm extract (DPE): 8 ml/kg of DPE. Group 5 aqueous date seed extract (DSE): 8 ml/kg of DSE. Group 6 combination aqueous extract of date palm and seed (DPSE): 8 ml/kg of DPSE. On the 15th day, after a 24-hour fast with free access to water, all animals (except for the control group) were induced gastric ulcers with 99.8% ethanol (5 ml/kg) according to a recent report (Simões et al., 2019). Each rat was individually placed on a chloroform-soaked cotton ball and left in a desiccator for 2–5 minutes; their abdomens were opened; samples of blood were drawn from the vein below the heart, spun to separate the serum, and kept at -20°C for further biological examination.

Stomachs were removed using esophagus and pyloric ligatures; juices were collected; gastric tissue was cleaned with normal saline; damage in the stomach area was analyzed using the Java-based image processing application (Image J software); The GU index was then calculated, and the damage to the mucosa was shown as a proportion of the

glandular stomach total surface area, which was estimated in square millimeters. The inhibition was found by using the following expressions:

GU.I = [GU area / total gastric area] × 100

(I%) = [(GU.I control − GU.I treated) / GU.I control] × 100%.

The formula followed the total acidity by 1 ml of gastric juice mixed with 1 ml of distilled water, adding two drops of phenolphthalein indicator, then titrated with 0.01N NaOH until a constant pink hue was detected (Reddy et al., 2012).

Acidity = Vol. of NaOH × N × 100 mEq/L 0.1

collected the mucus to measure the gastric mucosa by carefully scraping it off each rat using a flat glass slide. Then, the weight of the mucus was measured using an electronic weighing scale (A. Jaccob, 2015; Salga et al., 2012).

Preparation of subcellular fractions of the stomach

after GU induction was evaluated; the stomach was split in half, lift half frozen at -20 °C in phosphate-buffered saline, pH 7.4 (0.1 M) for homogenization, and the right half was fixed in 10% formaldehyde for histological studies.

GT and GSH measurement

Evaluated the levels of GT hormone and GSH in serum, then evaluated GSH in stomach tissue after lifting half stomach homogenized by Rat ELISA kits (ELK Biotechnology Co., Ltd., China, Wuhan) following the manufacturer's instructions.

Histological Assessment

The stomach was fixed in 10% formalin to prepare for histological examination and then paraffin-embedded. Standard hematoxylin and eosin staining was performed on histological sections cut at 4-5µm. Histopathologists use light dissection microscopes to examine tissue samples for signs of disease, such as swelling, bleeding, and necrotic spots of surface epithelium.

Statistical Analysis

The results were first examined using one-way analysis of variance (ANOVA) and presented as mean± standard deviation. After that, we compared the two groups

receiving treatment using Bonferroni's post hoc analysis. Significant differences were found between values where P was less than 0.05. The Windows version of GraphPad Prism (8.0, GraphPad Software, Inc., San Diego, CA) was used for the analysis.

Results

Qualitative phytochemical analysis

During the present study, a preliminary phytochemical screening was conducted on IDP.B fruit and seed extract, which indicated the presence of phenolic, tannin, and flavonoid components as shown in (Table 1). The flavonoids were detected through an intense yellow color that appeared after adding a few drops of NaOH, and after adding a few drops of dilute HCL, the extract turned colorless, indicating the presence of flavonoids. Additionally, the presence of tannins was indicated by a brownish-green color that appeared after adding one ml of 3% FeCl3. Furthermore, the presence of phenols was confirmed through the appearance of a bluish-black color that resulted after adding one ml of 2% FeCl3.

Phytochemicals	Colored appeared in the test	Water Extracts	
		DPE	DSE
Flavonoids Alkaline reagent test	**colorless**	+	+
Tannin Ferric chloride test 3% FeCl3	**Brownish green**	+	+
Phenolic Ferric chloride test 2% FeCl3	**bluish black**	+	+

Table 1. Qualitative Phytochemical Analysis of Iraqi dates palms (Phoenix dactylifera L. Cv. "Barhi") Palm and Seeds Extracted with Water solvents. (+) Present (-) Not detected. " DPE: aqueous extract of date palm, DSE: aqueous extract of date seed".

Body weight

Displays in (Figure 1) the subjects' weights at various points in the experiment. Rats exposed to IDP. B extract from fruit alone (Group 4) or combined with seed extract (Group 6) appeared different; a significant difference was found in the other groups. Less weight gain was seen in the group given just seed extracts (DSE Group 5).

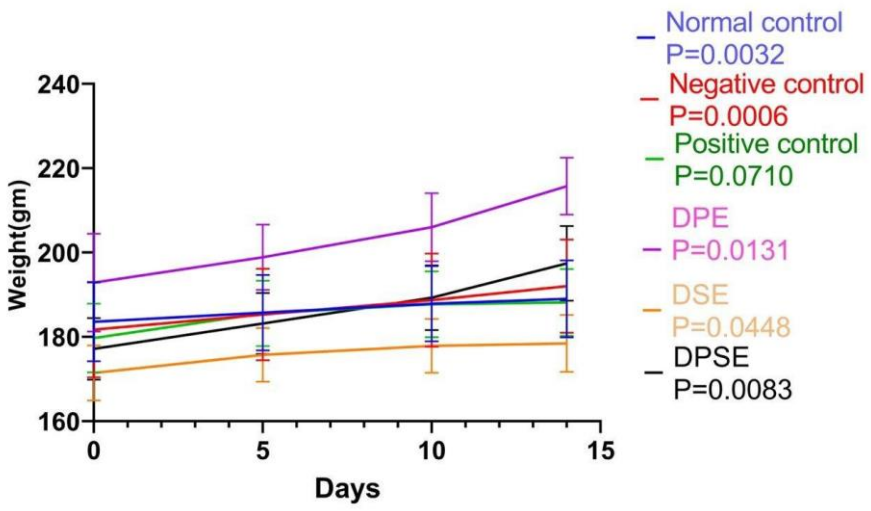

Figure 1. Variations in rat weights over the course of the experiments. * Indicate significant variations P<0.0001(n = 7). " DPE: aqueous extract of date palm, DSE: aqueous extract of date seed, DPSE: combination aqueous extract of date palm and seed".

Gastric fluid and mucus production

The result of the present work revealed a significant increase in gastric volume content in rats gavaged with ethanol in group 2 compared to normal control. Rats treated with IDP.B extract fruit alone (Group 4) or combined with seed extract (Group 6) had significantly lower gastric volumes compared to the negative control group (ulcer reference group 2). On the other hand, it is comparable to the positive and normal control groups. Gastric fluid volume in rats treated with seed extract alone (DSE Group 5) dropped significantly compared to that in the negative control group. However, it was still highly significant compared to the remaining groups, as shown in (Table 2).

Our data results demonstrated that prior administration of date palm and seed extracts alone or in combination to the GU induction absolute ethanol had a significantly higher gastric mucus weight compared to the ulcerated negative control group. Regarding mucus weight was significantly reduced in the ethanol-induced gastric ulcer negative controls compared to both normal and positive control groups as seen in (Table 2).

group	Gastric fluid volume (ml)	HCl concentration (mEq/L)	Mucus weight (g)	% inhibition
Normal control	**0.7000±0.1069**	**4.050± 0.3951**	**0.2143±0.014**	**-**
Negative control	**3.100±0.113[a]**	**57.14± 2.143[b]**	**0.10±0.01[a]**	**-**
Positive control	**1.000±0.2673**	**15.71± 2.020[a]**	**0.2429± 0.02**	**83.11**
DPE	**1.071± 0.03595**	**22.17± 1.480[a]**	**0.2929± 0.031**	**87.02**
DSE	**2.314± 0.1405[b]**	**44.29± 1.732[c]**	**0.3± 0.03**	**51.99**
DPSE	**1.843± 0.113**	**27.14± 2.641[a]**	**0.2943±0.033**	**88.63**
Value	**P<0.0001**	**P<0.0001**	**P<0.0001**	

Table 2. " DPE: aqueous extract of date palm fruit, DSE: aqueous extract of date seed, DPSE: combination aqueous extract of date fruit and seed". (a, b, and c) are significantly different at P<0.0001. Values are expressed as Mean± SER.
(I%) = [(GU.I control − GU.I treated) ÷ GU.I control] × 100%.

Gastric HCL and serum gastrin

shows that HCL concentration was significantly increased in induced group 2 compared to normal rats in (Table 2). The lowest HCL concentrations were detected in the positive control group, followed by the DPE and DPSE groups, but still higher than normal control Group 2. Rats treated with seed extract alone (DSE Group) had a significantly higher HCL concentration than the remaining groups except for the negative control group, which is considerably lower. Oral administration of ethanol significantly increases gastrin concentration and acidity, and pretreatment with date palm for two weeks was associated with significant protection, as clarified by decreased gastrin concentration in DPE Group 4, but still higher than normal and positive control groups. Rats gavaged with seed extract showed no significant differences in the induced group, as seen in (Figures 2 and 3).

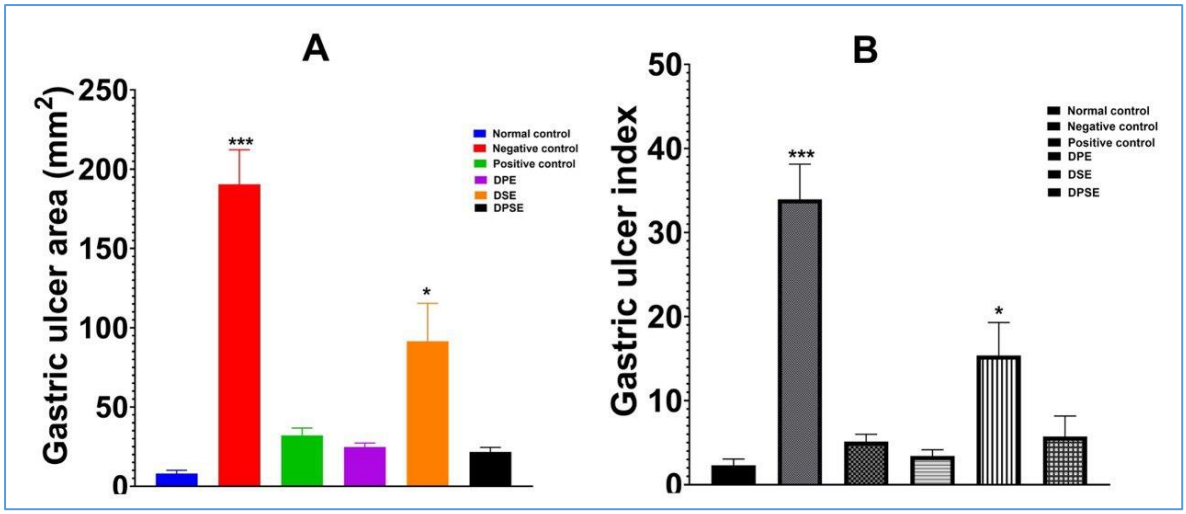

Figure 2. Effect of Iraqi dates palms (Phoenix dactylifera L. Cv. "Barhi") on A- the gastric ulcer area, B- the gastric ulcer index in the ethanol-induced ulcer model in the experimental rat model. *, *** Indicate significant variations P<0.0001 (n = 7). " DPE: aqueous extract of date palm, DSE: aqueous extract of date seed, DPSE: combination aqueous extract of date palm and seed".

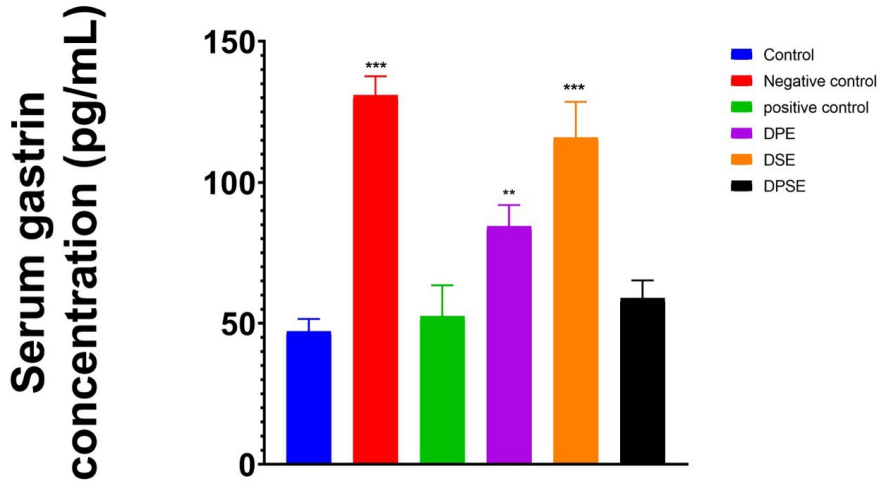

Figure 3. Effect of Iraqi dates palms (Phoenix dactylifera L. Cv. "Barhi") on Serum gastrin concentration in the ethanol-induced ulcer model in the experimental rat model. **, *** Indicate significant variations P<0.0001 (n = 7). "DPE: aqueous extract of date palm, DSE: aqueous extract of date seed, DPSE: combination aqueous extract of date palm and seed".

Photographic evaluation of gastric lesion

The gastric ulcer area was calculated using digital pictures under a dissection microscope, using Digital Image Tool 4.2. to measure gastric lesions, bleeding, and damage, as seen in Figure 4. In ulcer-induced Group 2, the severe mucosal injury was

observed with an ulcer area of 190.4± 21.8 mm^2, pre-administration of date palm and seed extract for two weeks associated with a significant reduction in ulcer area and ulcer index as summarized in (figure 4). Group3,4 and 6 showed a significant decrease in ulcer areas resembling positive and normal control groups. Ulcer area and index in rats treated with seed extract showed significant reduction compared to ulcer-induced but still highly significant compared to the remaining groups.

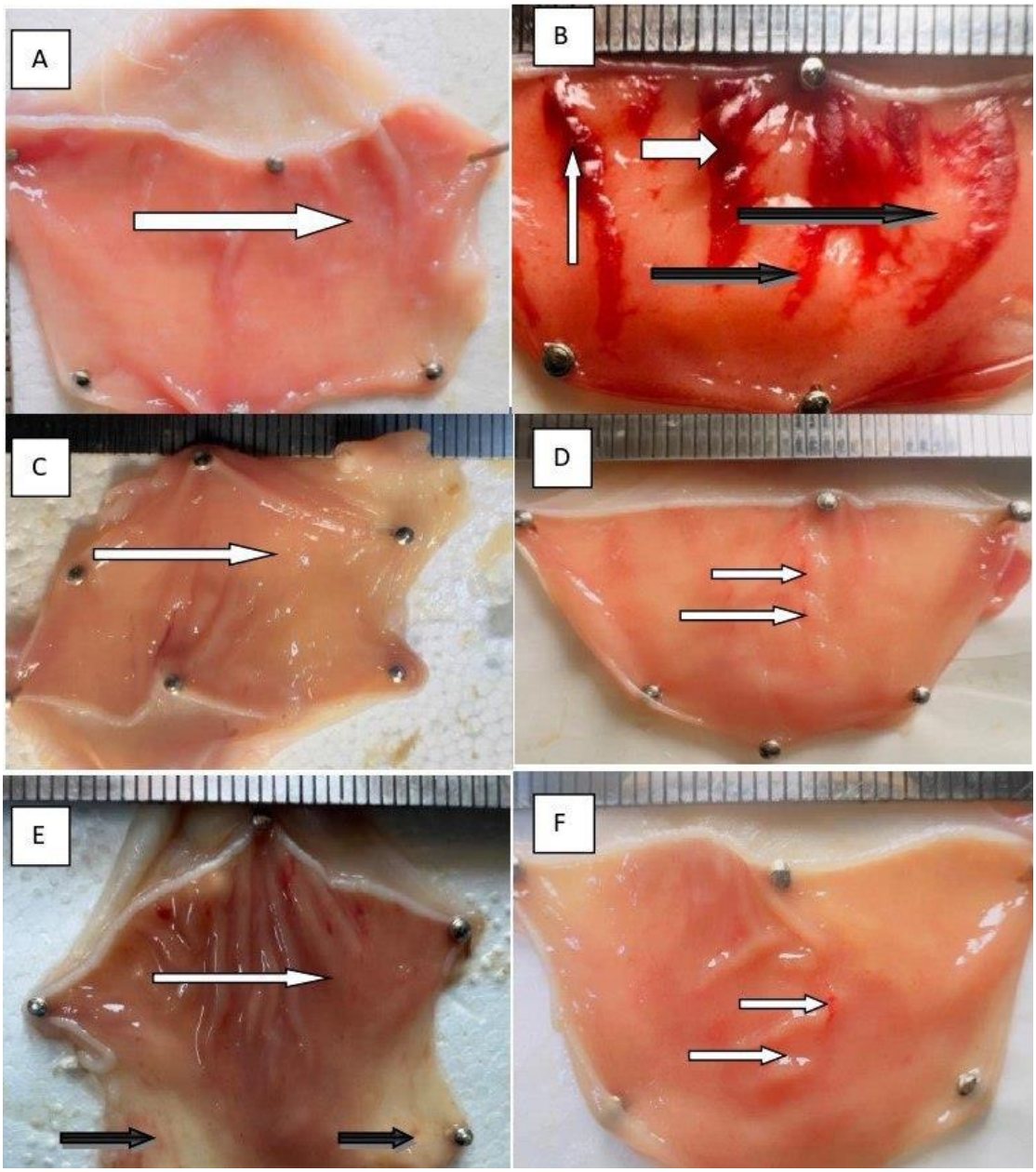

Figure 4. A gross study of the rat as shown; (A) Group 1: Normal control within normal limits tissue composition was noted (white arrow). (B) Group 2: The large irregular areas of gastric ulcers with hemorrhage are shown (white arrow), and the gastric mucosa of the fundus is diffusely hyperemic, with multiple petechiae (black arrow). (C) Group 3: within normal limits tissue components, maybe submucosal congestion was noted (white arrow). (D) Group 4: few

and tiny hyperemic (white arrow). (E) Group 5: Gastric submucosal congestion (white arrow) and acute gastritis (minor areas hemorrhage gastritis) may be noted (black arrow). (F) Group 6: few and very little hyperemic was shown (white arrow).

Histopathological Investigation

On histopathology, the stomach section of rats in the negative control Group2 exhibited loss of the epithelium and extension of the ulcer downward to the mucosa with necrotic debris, acute inflamed with severe congestion and edema (Figure 5B). On the other hand, As summarized in (Figure 5A-F), histopathological studies confirmed that pretreatment with DPE and DPSE reduces the effect of the ethanol on the stomach by significantly lowering congestion, bleeding, gastric ulcer, necrotic lesions, edema, and extensive disruption of the surface epithelium in gastric mucosa.

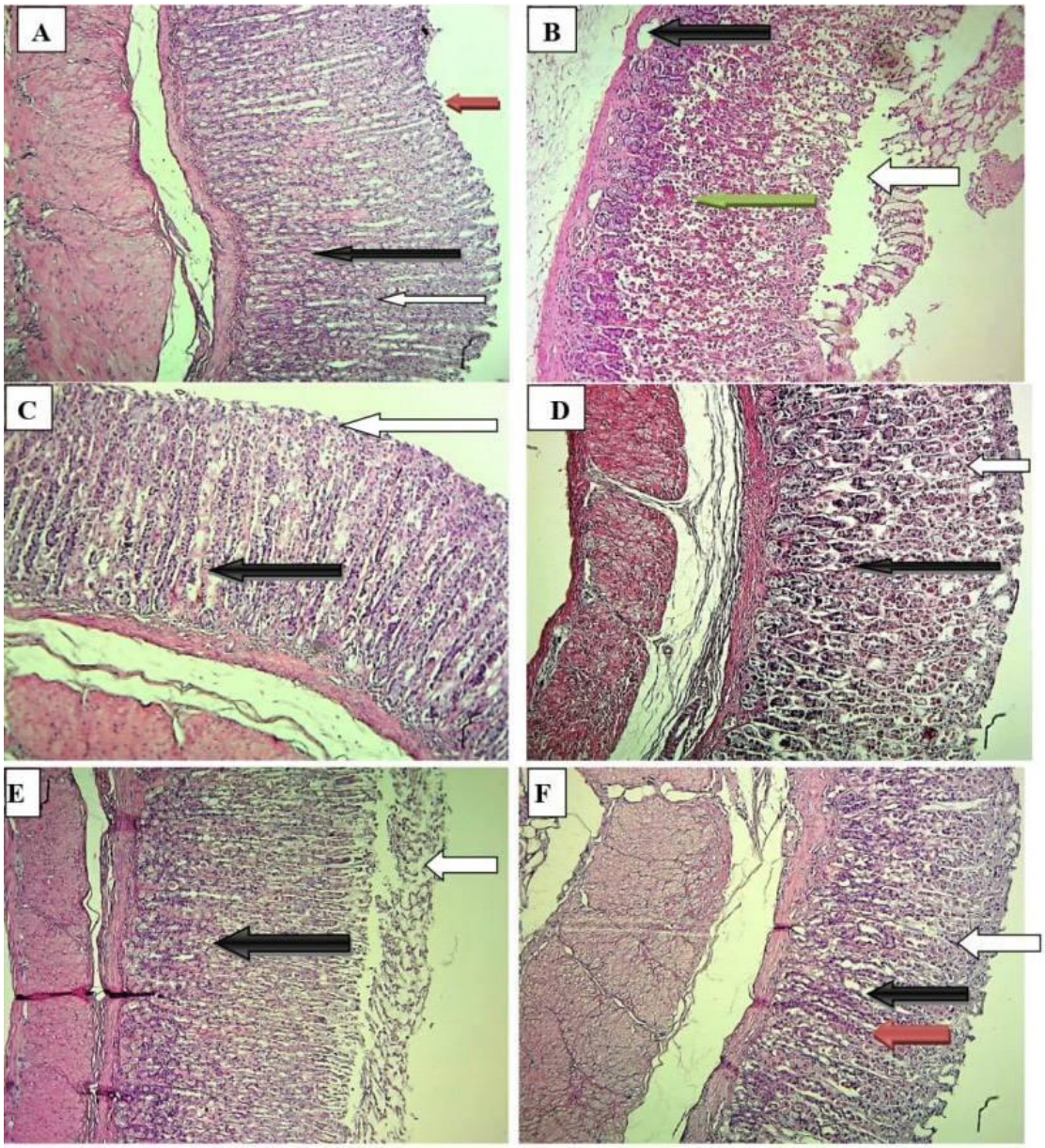

Figure 5. Microscopic study of gastric mucosa in rat shown: (A) Group 1: displayed gastric antral epithelium has long pits (white arrow), with short glands (black arrow), and normal epithelium surface mucosa (red arrow) (B) Group 2: presented with note the loss of the epithelium and extension of the ulcer downward to the mucosa with necrotic debris (white arrow), acute inflamed with severe congestion (green arrow) and edema (black arrow). (C) Group 3: normal gastric mucosa (white arrow), with mild edema, may be noted (black arrow). (D) Group 4: note normal epithelium mucosal respectively (white arrow), with mild inflamed and mild edema (black arrow). (E) Group 5: shedding of the gastric antral epithelium (white arrow), with mildly inflamed mucosa (black arrow), (F), group 6: normal with mild intact gastric antral epithelium (white arrow), with normal gastric pits (red arrow), and mild gastric mucosa (black arrow). H&E, 20X.

Estimation of antioxidant activity

Absolute ethanol administration in negative control Group 2 significantly reduced

serum and gastric tissue glutathione concentrations compared with the remaining groups, as seen in (Figure 6). Meanwhile, rats pretreated with DPE and DPSE caused a significant increase in both serum and gastric concentrations, resembling positive and normal control groups. Rats treated with seed extracts showed a minor improvement in serum glutathione concentration but not gastric tissue level, as documented in (Figure 6).

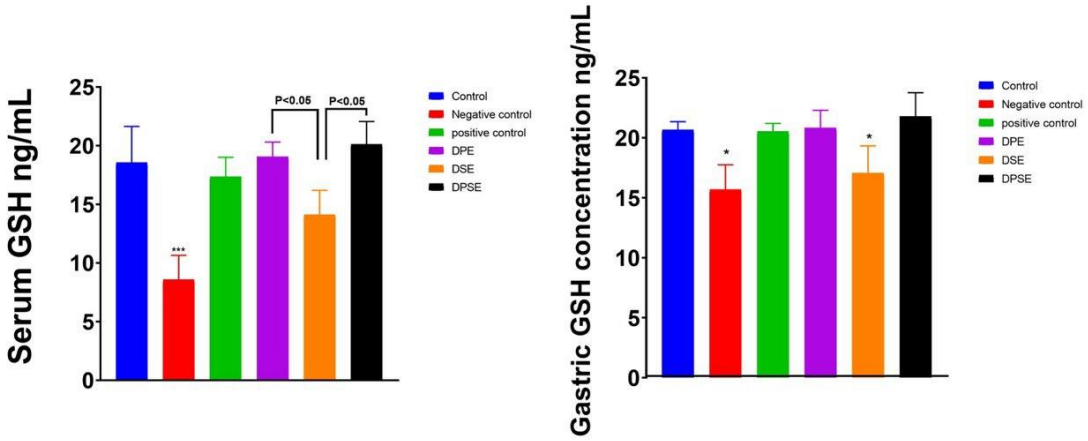

Figure 6. Effect of Iraqi dates palms (Phoenix dactylifera L. Cv. "Barhi") on A- Serum glutathione (GSH), B- Concentration of GSH in stomach tissue in the ethanol-induced ulcer model in the experimental rat model. *, *** Indicate significant variations P<0.05 (n = 7). "DPE: aqueous extract of date palm, DSE: aqueous extract of date seed, DPSE: combination aqueous extract of date palm and seed".

Discussion

DP was widely available in south Iraq and is a popular fruit across the country, particularly in Basra (Ghnimi et al., 2017). Gastric ulcers are caused by multiple factors, including oxidative stress, lipid peroxidation, pepsin release, and free radical generation through matrix metalloproteinases (da Silva et al., 2013). Modulation of these factors is the primary approach in PU treatment modalities. Alcohol, nonsteroidal anti-inflammatory drugs (NSAIDs), and Helicobacter pylori are only some of the stressors and aggravators that may cause stomach ulcers (Parra-Cid et al., 2011). In this study, the model involved inducing stomach ulcers in rats by administering pure ethanol orally (Simões et al., 2019). Rats with ethanol-induced stomach ulcers were used to examine the antiulcer properties of IDP.B extract. Absolute ethanol has immediate and long-lasting effects on the gastrointestinal mucosa, such as disruption of blood flow to the mucosa, and direct mucosal damage (J. W. Konturek et al., 1998).

Absolute ethanol is toxic to the stomach because it directly disrupts the gastric mucosa's barrier, resulting in hydrogen back diffusion and, ultimately, necrosis and allowing harmful substances to enter the bloodstream and potentially cause systemic effects; these alterations in the microvasculature (quick and severe vasoconstriction coupled by fast and forceful arterial dilatation) harm to the stomach mucosa caused by oxyradicals as a result of hypoxia and subsequent regeneration (Terano et al., 1989). Increased lipid peroxidation is also linked to the overproduction of free radicals caused by ethanol-induced damage to the stomach mucosa (Kahraman et al., 2003). Rats given ethanol have elevated amounts of gastrin hormone (GT), which causes the parietal cells to hypersecretion acid and develop a stomach ulcer. The production of an inhibitory antral hormone, which reduces gastric output, co-occurs with the inhibition of gastrin release (Mercer et al., 1997). In this study, the results of this investigation revealed that rats given ethanol suffered extensive damage to their gastrointestinal mucosa, including swelling, redness of the mucosal surface, erosion, and puncture, a straight line, cord-like, and flaky bleeding. The rate of injuries was completely consistent with prior studies (Raish et al., 2018). various factors such as infection, inflammation, or tissue injury. Additionally, free radicals can further exacerbate the damage by initiating a chain reaction of oxidative stress and inflammation in the stomach mucosa (Kvietys et al., 1990).

Several antiulcer drugs, such as proton pump inhibitors and histamine receptor blockers, have been approved in the treatment guidelines for peptic ulcers (Mard et al., 2008). Famotidine, an H2-receptor antagonist, was chosen as the standard antiulcer medication for this investigation because of its proven ability to bind to H2 receptors and regulate stomach acid output (Taha et al., 1996). Furthermore, famotidine can protect against lipid peroxidation and protein oxidation in an ethanol-induced gastric ulcer model. (Pradeepkumar Singh et al., 2007).

The DP aqueous extract used in this study is abundant in antioxidant polyphenols, minerals, and other compounds, which are high in insoluble fiber, and essential for gastrointestinal healing (M. A. Al-Farsi & Lee, 2008). In 2005, Al-Qarawi et al. discovered that DP reduced damage to the gastric mucosa caused by 80% ethanol by decreasing gastric acid, GT, and histamine levels (Al-Qarawi et al., 2005). Date seed and fruit extract stimulate gastrointestinal transit activity in rats and confirm their use

in traditional Tunisian medicine for constipation (Souli et al., 2018). In contrast, according to Musa et al. (2017), increasing the dosage of DP extract does not protect the gastric mucosa from ethanol damage. The study suggests that the extract contains saponin, which has been proven to be harmful to cells by creating pores and causing the degradation of certain cell membranes (Musa et al., 2017).

In this work, GT decreased by the Aquas extract of IDP.B, GT linear peptide is a gastrointestinal hormone produced by gastrin cells that, among other activities, modulates gastric acid secretion, produces histamine, and controls gastric endocrine cell proliferation. (Kovac et al., 2011).

In this study, we used the GSH parameter to evaluate the effect of IDP.B on antioxidant biomarkers; an increase in GSH meant the protection of the stomach mucosa from ulcerations brought on by stress (Hirota et al., 1989). GSH plays a crucial role in the cytoplasm. Excessive lipid peroxidation may lead to GSH depletion, while GSH depletion can increase lipid peroxidation. (Büyükokuroğlu et al., 2002). Protecting cells from electrophiles and free radicals is a significant function of GSH. It plays a crucial role in maintaining cellular homeostasis. Besides being a free radical scavenger, GSH is involved in various enzymatic reactions that help detoxify harmful substances within the cell. GSH also regulates cellular redox balance, ensuring the proper functioning of vital cellular processes. It is crucial to keep the SH groups in proteins and nonproteins in their reduced forms (Pastore et al., 2003).

IDP.B extracts contain phenolic compounds, which make them stomach-friendly. Several researchers have concluded that these compounds are the principal antioxidants or free radical scavengers (Potterat, 1997). In addition, IDP.B extracts contain tannins that inhibit ulcer development by either constricting blood vessels or precipitating proteins. This encourages microprotein precipitation at the ulceration site, producing a waterproof covering over the lining that obstructs gastrointestinal secretions and protects the mucosa from irritation (Al-Rehaily et al., 2002). Flavonoids, which are also present in IDP.B extracts, are effective against ulcers and protect the gastrointestinal tract (Zayachkivska et al., 2005). Previous studies have explained the mechanisms of DP extracts. In this study, an aqueous extract of IDP.B has been found to reduce hyperacidity and improve GSH levels. The stomach mucosa showed fewer red patches, lesions, or perforations, confirming these mechanisms.

Conclusions

The Oral administration of date palm extract and, to a lesser extent, seed extract showed significant gastroprotective effects comparable to that observed in the treated group in absolute ethanol-induced peptic ulcer such protection was evidenced by decreasing acid and gastrin secretion, increasing mucus content, reducing ulcer area, improving antioxidant activity, and alleviating gastric injury These results make date palm a promising candidate for future clinical trial studies.

Ethical approval

All procedures involving animal subjects were carried out in conformity with NIH regulations. The University of Basra's Animal Ethics Committee, EC11, approved these trials in October 2022.

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