

Ameliorative Effects of Pomegranate Molasses and Fig on Carbon Tetrachloride Hepatotoxicity in Rats

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العدد الأربعون نوفمبر 2024

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Abstract :

The possible preventive effects of pomegranate and fig against hepatocellular toxicity induced by carbon tetrachloride (CCl₄) in male rats were studied. The pomegranate molasses and fig indicated the existence of flavonoid and phenolic components in their entirety. Each of the eight groups of rats contained six rats; group (1) served as the negative control, or normal group, and the rats in the other groups received subcutaneous injections of carbon tetrachloride (CCl₄) twice weekly for six weeks to induce hepatocellular toxicity. Group (2) was left as a positive control, while the rest groups were administered with (2.5%, 5% and 10%) pomegranate molasses or dried fig, for 6 weeks, respectively. Blood samples were collected at the conclusion of the experiment for biochemical examination. The results showed that, in comparison to the normal control group, the rats with hepatocellular toxicity had significantly higher serum levels of AST, ALT, total protein, creatinine, and blood urea nitrogen. The administration of (2.5%, 5% and 10%) pomegranate and dried fig preserved liver caused a significant reduction in serum levels of AST, ALT, total protein, creatinine and blood urea nitrogen while an increase in hemoglobin and RBC was greater in pomegranate especially (10%) group. This study concluded that pomegranate and dried fig could be implemented in the protective effect of hepatotoxicity in rats and resume the anemic effect caused by CCl₄. Therefore this study recommends Increased dietary intake of pomegranate and dried fig may be beneficial for patients with liver and kidney diseases as a preventative measure.

Keywords: Pomegranate Molasses; Fig; Carbon Tetrachloride; Hepatotoxicity ; Liver enzymes; Kidney Function; Rats.

Introduction

Oxidative stress is brought about by a decrease in antioxidant defense mechanisms or the incapacity of different antioxidant mechanisms to scavenge excessive amounts of reactive oxygen species (ROS). Thus, degenerative illnesses such as hepatopathies (Hensley *et al.*, 2000) and nephropathies (Ateşşahin *et al.*, 2003) might happen. The first tissues to suffer from oxidative stress brought on by drugs, alcohol, pathogenic agents, hazardous industrial chemicals, dietary additives, and air and water pollution are the liver and kidneys. Moreover, the development and advancement of cancer and liver disease are significantly influenced by free radicals and ROS (Jemal *et al.*, 2007).

An industrial solvent called carbon tetrachloride (CCl₄) is widely utilized as a xenobiotic to cause chemical liver harm. In mouse models, CCl₄-induced oxidative stress is frequently utilized to assess whether synthetic or natural compounds provide protection against drug-associated hepatotoxicity and nephrotoxicity (Haghi *et al.*, 2014).

The Pomegranate (*Punica granatum*) name has been verified as appropriate by the websites "MPNS" and "World Flora Online." Alvarez-Cervantes *et al.* (2021) state that the pomegranate's exceptional qualities can be traced back to its historical endemic countries, which date back to the early Bronze Age (3500–2000 BC). This plant is indigenous to the Himalayas, and according to botanical data, the first areas where humans cultivated pomegranates were in central Asia, which includes countries that stretch from spanning the Middle East, the European Mediterranean region, northern Africa, and Iran and northern India (Abdel Moneim, 2012; Vučić *et al.*, 2019). But nowadays, It is also grown in China, Greece, Italy, Morocco, Spain, Russia, North and South America, and Uzbekistan (Sohrab *et al.*, 2015, 2017; Vučić *et al.*, 2019). The most widespread religions in human history, such as Islam, Judaism, Zoroastrianism, and Christianity, along with old folktales that depict pomegranates as symbols of life, femininity, and immortality (Akhtar *et al.*, 2017). The pomegranate is native to the Middle East (Kandyliş & Kokkinomagoulos, 2020).

One of the most well-known traditional edible plants is the pomegranate (Xie *et al.*, 2008). It is described as the "Food of Gods," signifying plenty, fruition, and success, in the Bible, the Torah, the Islamic holy book (Quran), and the Babylonian Talmud (Seeram *et al.*,

2006). Pomegranate (*Punica granatum L.*) have a wide range of beneficial phytochemicals, including tannins, alkaloids, and colors (Zarei *et al.*, 2017), It is a plant used in popular folkloric medicine for the treatment of various diseases (Ajaikumar *et al.*, 2005). It is an important source of organic acids, anthocyanins, flavonols, proanthocyanidins, hydrolysable tannins punicalagin and punicalin (Vučić *et al.*, 2019 & Hou *et al.*, 2019 & Afaq *et al.*, 2005), ellagic and gallic acids (Raffaele *et al.*, 2021) and contains vitamin C (Turk *et al.*, 2008). Recent studies have demonstrated its anticancer activity (Kumar and Das, 2022).

Numerous studies on the in vivo characteristics of pomegranates, namely their anti-atherosclerotic capacity, have been published in addition to their antioxidant capacity (Rosenblat *et al.*, 2015). It have antioxidant properties because of phenolic components such phenolic acid and flavonoids (Moradnia, et al., 2024).

Howell & D'Souza, (2013) reported that pomegranate juice possesses antiviral properties that prevent viruses from attaching to host cell receptors. Tomás-Barberán *et al.*,(2017) demonstrated that gut microbiota-derived urolithins and punicalagins, in particular, have anti-inflammatory properties that are mediated by the peroxisome proliferator-activated receptor transcription factors (PPAR), which inhibit the activation of nuclear factor κ B (Feng *et al.*, 2020 & Ciavarella *et al.*, 2020). Furthermore, new research indicates that some components of pomegranate peel extract may be able to protect against SARS-CoV-2 (Suručić *et al.*, 2021), anti-carcinogenic (Khan, 2012), anti-inflammatory properties (Stefanou, *et al.*, 2020), as well as therapeutic efficacy (Peñalver-Mellado *et al.*, 2023).

In the Middle East, pomegranate molasses (PM), a concentrated form of pomegranate juice, is commonly consumed and may contain more potent antioxidants than the juice itself. It is a concentrated product made simply by boiling the juice, and it is often used in salads and many other foods to improve the taste and scent qualities in Egypt (Abd Elmonem, 2014).

Fig is referenced in Surah Al-Tin: 1-2 of the Holy Quran where God Almighty takes the form of a holy oath and says, "By the fig and the Olive, and by Mount Sinai." Given the significance of this scripture, God Almighty vowed to fig. The *Ficus carica* genus has over 800 variants that are grown in warm climates. Figs are a seasonal fruit that are good either fresh or dried, or in juice or jam. They can be collected twice a

year. The fig tree, is one of the oldest crops ever domesticated. It comes from the Middle East and belongs to the family Moraceae (Mulberry). The fruit is currently being grown in various parts of the world because of its health, nutritional value, and economic significance (Abdel-Rahman *et al.*, 2021; Wojdyło *et al.*, 2016). It can be eaten raw, dried, or processed (Dueñas *et al.*, 2008). The main producers of figs in the west and east Mediterranean region include Turkey, Egypt, Tunisia, Iran, Morocco, and many other countries. Fig production has increased in Brazil, the US, China, Portugal, and other countries (Veberic and Mikulic-Petkovsek, 2015).

The most prevalent colours of fig fruit (*Ficus carica*) are purple and green, though the exact colour varies based on the subspecies to which it belongs and the planting region. Furthermore, because fig trees are employed as objects of religious and cultural worship throughout the regions of the world where they originated, they have enormous cultural and religious value (Badgujar *et al.*, 2014). Because of their appealing sensory and organoleptic features as well as their capacity to promote health, they have good economic potential in addition to their use in a variety of cultural contexts. Scientific study has provided empirical evidence regarding the significance of fig fruits and leaves, particularly in relation to human diets and health. Various tree parts have been found to have substances and qualities that promote health and are effective against a number of known lifestyle disorders (Abdel-Rahman *et al.*, 2021; Amessis-Ouchemoukh *et al.*, 2017).

This is further supported by the fact that the traditional Ayurvedic and Siddha medical systems, which are popular in India and other Middle Eastern nations, have already shown the medicinal value of this tree (Badgujar *et al.*, 2014).

Numerous fig tree sections have been investigated and found to have health-promoting properties in the past. For instance, it has been shown that bioactive chemicals found in fig seeds possess anti-oxidant qualities and can help the body's oxygen imbalances (Nakilcioğlu-Taş and Ötleş, 2021). This could be explained by phytosterol and its constituents, including stigmaterol and β -sitosterol, which have the ability to decrease cholesterol (Barolo *et al.*, 2014; Jeong and Lachance, 2001).

Apart from the seed, Boyacıoğlu *et al.* (2021) and Wojdyło *et al.* (2016) have reported the potential therapeutic benefits of fig fruit and leaf against chronic and lifestyle disorders, including diabetes and cancer. An earlier study on the anticancer properties of fig leaf extract,

showed 67–80% inhibition of the Hep2 and HepG2 cell lines (Abdel-Rahman *et al.*, 2021). Boyacıoğlu *et al.* (2021) have reported on the promising of latex-derived antiproliferative agents from *Ficus carica* on several types of HT-29 cancer. Mild constipation can be treated with the syrup (George *et al.*, 2023).

Several research (Al-Snafi, 2017; Chauhan and Tanwar, 2015; Khan *et al.*, 2011; Pal, 2020; Sadia *et al.*, 2014; Verma *et al.*, 2015; Vora *et al.*, 2017) reported that carotenoids, organic acids, vitamin E, and phenolics are present in the fruit of fig and it is a great source of phytochemicals that improve health. Figs are a nutrient-dense fruit. Different fruit kinds, their state (fresh or dry), their location, the type of soil they are in, and the overall climate of the fruit's surroundings all affect the amounts and concentrations of these micro and macronutrients. Figs are high in minerals like iron, calcium, phosphorus, potassium, and sodium, which are required for the physiological functioning of the human body (Al-Snafi, 2017; Chauhan and Tanwar, 2015; Mahmoudi *et al.*, 2018; Pal, 2020).

The dried fruit has been shown to contain a high concentration of carbs, ranging from 65.2% to 73.5%, but fresh fig fruits contain only 8-20% (Pal, 2020).

Fruit, latex, leaves, and roots all include volatiles, aliphatic alcohols, fatty acids, hydrocarbons, sterols, anthocyanins, and other secondary metabolites. Furthermore, figs are a vital source of vitamins (riboflavin and thiamin) and minerals (including potassium, iron, and calcium). Fresh fruit from *Ficus carica*, extracts, and extracted bioactive components showed a wide range of health-promoting characteristics. *Ficus carica* peel extracts contained a variety of nutrients and bioactive substances, such as fatty acids, organic acids, tocopherols, phenolic components, and free sugars (George *et al.*, 2023).

Ficus carica(FC) is recognised for its biological and health properties, which include antifungal, antihelminthic, acetyl cholinesterase inhibition, and anticarcinogenic activity. These properties are found in its leaves, roots, fruit, and latex. Traditional medicine uses fig to treat a variety of respiratory, gastrointestinal, endocrine, and reproductive conditions. It is applied to infections of the urinary and gastrointestinal tracts. In addition, the fig addresses conditions like ulcers, diabetes, anaemia, cancer, leprosy, liver problems, and skin disorders. Research revealed the uses of fig extracts as functional food ingredients, and clinical studies confirmed its impacts on health (George *et al.*, 2023).

FC belongs to the plant family Moraceae.. It's a fruit that goes by the name "fig." The genome of FC is made up of several gene groups. Depending on the plant component and extraction solvent, different FC-derived products (FCDP) have varying amounts of phenols, flavonoids, ortho-diphenols, proanthocyanidins, flavonols, and ascorbic acid. For instance, High amounts of phenols and flavonoids are present in the methanolic FC latex extract, as indicated by the ratio of total phenolic content (TPC) to total flavonoid content (TFC), which is frequently near to 4 (Abdel-Aty *et al.*, 2019). Numerous pharmacological characteristics, Each of the above stated phytochemicals has been associated with various benefits, such as anti-oxidative, anti-apoptotic, anti-microbial, anti-tumorigenic, and anti-inflammatory properties (Abdel-Aty *et al.*, 2019 & Ali *et al.*, 2012).

FC active compounds with a high potential to bind various molecular targets have been found through in silico investigations (Gurung *et al.*, 2021 & Mansoor *et al.*, 2023). The effects of FCDP, which are centered on reversing the impairments to the dysregulation of oxidative stress, inflammation, cell cycle, glucose and lipid metabolism, have been experimentally evaluated and supported by in vivo and in vitro research. These effects are condition-, disease-, and cell-specific rather than generic. For instance, FC mostly promotes cell death in tumoral tissues (Morovati *et al.*, 2022), while at the same doses, FC frequently has no harmful effects on cells that have grown properly. Moreover, FC might help stem cells maintain their viability and regulate their stemness behavior. The proliferation and maintenance of germ line stem cells treated with FC were seen in (Makoolati *et al.*, 2022). Therefore, FC is advantageous for use in natural applications or for use by pharmacologists and bioengineers to synthesise products such as polymer scaffolds and nanoparticles (Shahzad Shirazi *et al.*, 2022 ; Jacob *et al.*, 2017 ; El-Sayed *et al.*, 2019).

This study looked at how dried fig and pomegranate molasses might lessen the hepatotoxicity of carbon tetrachloride in rats by analyzing liver function, kidney function, blood count, and weight of rats with hepatocellular toxicity before and after treatment with pomegranate molasses and fig.

Materials and Methods

Materials:

Rats and Diet:

Researchers bought male Sprague Dawley albino rats weighing 170 ± 10 g from Cairo University's Faculty of Veterinary Medicine's animal laboratory in which the experiment was carried out.

Components of the basic diet were purchased from El-Gomhorya Company in Cairo, Egypt.

The institutional Animal Care and Use Committee (ARC-IACUC) Agricultural Research Center, has approved the protocol. The recognized number of Cairo University (ARC) is HU 78 24.

Chemicals and Fed Ingredient:

Kits for measuring liver and kidney function with carbon tetrachloride (CCl_4) were acquired from Sigma-Aldrich Co. (St. Louis, Missouri, USA). We bought the pomegranate from the nearby market.

Methods:

Pomegranate Molasses (PM) and Fig (F) Preparation:

Pomegranate fruits were bought from the local market, cleaned, skinned, and crushed. The fluid was then extracted, filtered, and concentrated using slow heating in an open vessel until the refractometer read 75% of the total soluble solids (Al-Marazeeq *et al.*, 2017)

While fig dried on solar energy to turn it into powder

Preparation of Basal Diet:

Reeves *et al.*'s (1993) instructions were followed in preparing the basal diet (AIN-93M). The diet was designed to provide rats with the appropriate amounts of nutrients. PM or fig dried powder was added at levels of 2.5%, 5% and 10% (on the diet).

All study groups consume diets that are composed of 14% protein, 4% salt mixture, 1% vitamin mixture, and 10% fat.

Carbon Tetrachloride (CCl_4):

Carbon tetrachloride (CCl_4) as a 10% liquid solution. Used as toxic material for hepatic poisoning in accordance with Passmore & Eastwood(1986).

Induction of Hepatotoxicity

The method of CCl_4 -induced hepatotoxicity that we employed in this investigation (10 ml/kg of a 1:1 v/v combination of CCl_4 and olive oil) was previously reported by Li *et al.* (2015).

Determination of Total Phenols and Total Flavonoid:

Total phenolic and total flavonoid content concentrations were calculated using the method of (Zilic et al., 2012) and expressed as mg of gallic acid equivalent (GAE) and catechin equivalent (CE) per 100 g FW of sample, respectively.

The modified approach of Shimada et al., (1992) was utilized to measure the 1,1-diphenyl-2-picrylhydrazil (DPPH) radical scavenging activity.

Experimental Design:

The basal diet was supplied to forty eight male albino rats, and they had unlimited access to water. Prior to beginning the experiment for acclimatization, animals were kept for one week at typical conditions of humidity (50–60%), temperature (20–25°C), and light (12 hours of light and 12 hours of darkness). Pomegranate molasses or dried fig (25, 50, 100) gm for each percentage was solved in 1000 ml distilled water to 10 min to obtain (2.5%, 5%, 10 %) solvent respectively. Then, refrigerated the solvent for the experiment. Rats were divided into eight groups of six animals each as follows:

- Group 1: (N = 6) fed on a Basel diet and used as a negative control (Negative control).
- Group 2: Fed on a Basel diet, injected with CCl₄ according to the above protocol and used as hepatotoxicity control.
- Group 3: Fed on a Basel diet with injected CCl₄ as above and administered (1ml/ kg/rat) daily from 2.5 % pomegranate molasses solvent for 6 weeks.
- Group 4: Fed on a Basel diet, injected with CCl₄ as above and administered (1ml/ kg/rat) daily from 5 % pomegranate molasses, for 6 weeks.
- Group 5: Fed on a Basel diet, injected with CCl₄ as above and administered (1ml/ kg/rat) daily from 10 % pomegranate molasses, for 6 weeks.
- Group 6: Fed on a Basel diet supplemented with 2.5 % dried fig powder and injected CCl₄ as above for 6 weeks.
- Group 7: Fed on a Basel diet supplemented with 5 % dried fig powder and injected with CCl₄ as above for 6 weeks.
- Group 8: Fed on a Basel diet supplemented with 10 % dried fig powder and injected CCl₄ as above for 6 weeks.

In the first six weeks of the experiment, animals of groups (2), (3), (4),(5),(6),(7) and (8) followed the above protocol to induce

hepatotoxicity in rats. At the end of experiment after ~6 weeks of the experiment, rats were sacrificed after overnight fasting. Samples of blood were drawn from the portal vein as much as feasible and placed in dry, clean tubes to clot at room temperature (26–27 °C). After centrifuging the blood samples for 15 minutes at 3000 rpm, the serum was carefully separated and stored at -20°C until analysis.

Biochemical Analyses

Serum Analysis:

Blood was drawn, and liver function tests (ALT, AST) were performed using serum from non-heparinized blood. Alanine aminotransferase (ALT) and aspartate aminotransferase (AST) in serum using the Young (2001) technique.

Kidney Functions Parameters:

Serum alkaline phosphatase (ALP) was done based on the procedure outlined by Wenger et al., (1984). The procedure outlined was used to determine the serum total protein concentration by Burtis and Ashwood (1999). Blood urea nitrogen was calculated using the procedure outlined in (Fossati et al., 1980). The serum level of creatinine was determined as the principle as stated by Delanghe and Speeckaert, (2011).

DPPH Radical-Scavenging Activity:

For every sample, 0.1 g was produced in 50 milliliters of methanol. A portion of the extract (100 µl, 0.2 mM) was combined with a methanol-dissolved DPPH radical. After stirring, the mixture was allowed to stand in the dark for fifteen minutes. Next, the absorbance was measured in relation to a blank at 517 nm. The formula for calculating the % scavenging effect was $[(A_0 - A_1) / A_0] \times 100$. Thus, according to Brand-Williams et al. (1995), A₀ represents the absorbance of the control (without sample) and A₁ represents the absorbance when the sample is present.

Hematological Parameters:

Hema Screen 18 automated hematology analyzer (Hospitex Diagnostics, Sesto Fiorentino, Italy) was used to measure the following parameters in heparinized blood: total leukocyte count, relative differential leukocyte count including neutrophils and lymphocytes, platelet count, hemoglobin concentration (Hb), mean corpuscular hemoglobin (MCH), mean corpuscular hemoglobin concentration (MCHC), packed cell volume (hematocrit, PCV), mean cell volume (MCV), red cell distribution width-coefficient of variation (RDW-CV), hemoglobin concentration (Hb), mean corpuscular hemoglobin

concentration (MCHC), mean corpuscular hemoglobin concentration (MCHC), hemoglobin concentration (Hb), mean corpuscular hemoglobin (MCH), mean corpuscular hemoglobin concentration (MCHC).

High-Performance Liquid Chromatography (HPLC) of Phenols in (PM and fig):

Equipped with a quaternary pump, a Kinetex® 5µm EVO C18 100 mm x 4.6 mm (Phenomenex, USA), the Agilent 1260 Infinity HPLC Series (Agilent, USA) operates at 30°C. A ternary linear elution gradient with (A) HPLC grade water 0.2% H₃PO₄ (v/v), (B) methanol, and (C) acetonitrile is used to produce the separation. A 20 µL injection volume was used. Detection: VWD detector, as specified (Agilent Application, 2014), set at 284 nm.

Histopathological Examination:

Tissue samples of liver were removed With great care, the sample was fixed in 10% neutral buffered formalin, dehydrated in increasing alcohol grades, cleaned, embedded in paraffin, sectioned at 5 µm thickness, stained with H&E, and inspected under a microscope (Bancroft *et al.*, 1996).

Statistical Analysis

Using the statistical software for social science (SPSS) version 16, a one-way analysis of variance (ANOVA) and the Duncan Test were used to compare all treatment groups. The data were presented as mean ± STD, with $p < 0.05$ indicating significance (Bailey, 1995).

Results and Discussion

Serum Analysis:

Kidney functions (urea ,creatinine) and total protein in rats from six weeks of experimentation among the various groups. presented in Table1.

Table 1, presented that serum levels of creatinine of the treated rat did not significantly differ compared to the normal control rats (negative control group), except Urea that was Significantly higher values of urea were noticed for positive and negative control than those of the other experimental groups. Administration of (PM) has a protective effect against CCL₄-induced some blood parameters elevation.

Table (1): Renal Functions (Creatinine, Urea, and Total Protein) in Rats fed on Pomegranate Molasses(PM) and Fig(F) of the different experimental groups after 6 Wk.

Groups / Parameters	Urea mg /dl	Creatinine mg /dl	T.P (g/dl)
Negative Control	44.00 ^c ±1.00	0.85 ^a ±0.05	5.00 ^b ±0.10
positive Control	68.50 ^a ±2.00	1.00 ^a ±0.10	5.65 ^a ±0.15
2.5%(PM)	68.00 ^a ±2.50	1.20 ^a ±0.20	5.45 ^{ab} ±0.25
5%(PM)	65.50 ^b ±1.00	1.00 ^a ±0.00	5.25 ^{ab} ±0.15
10%(PM)	57.00 ^b ±0.50	0.90 ^a ±0.10	5.25 ^{ab} ±0.15
2.5% F	68.60 ^a ±1.28	1.06 ^a ±0.04	5.62 ^a ±0.12
5% F	65.00 ^b ±4.04	0.92 ^{ab} ±0.04	5.20 ^{ab} ±0.07
10% F	64.60 ^b ±2.20	0.82 ^b ±0.07	5.3 ±0.33

Mean values in each raw having different superscript (a, b, c) denote significant Difference, Urea : (N: 15 – 45 mg/dl) Creat.: (N: 0.5 – 1.5 mg/dl) T.P : (N: 6 – 8 g/dl)

Table 1 also shows that treatment with CCL₄ resulted in a significant increase in total protein (T.P) compared to the negative control group.

However, CCL₄ therapy resulted in a significant reduction in total protein levels when compared to the negative control group. Rats treated with pomegranate peel at all levels showed a substantial decrease in total protein, values when compared to the positive control group. Pomegranate peel significantly increased blood albumin levels at all levels, with no significant difference between the 5% and 10% levels compared to the negative control group. Total protein levels increased significantly in contrast to the group under positive control. On the other hand, the creatinine level showed a lower concentration than the negative control at a concentration of 10%, the fig concentration was at a level of 2.5% in total protein, which was near to the positive control. In contrast to the negative control, the level of urea was 2.5%, which was the highest percentage.

In this respect, Shima (2022) shows the effect of three amounts of pomegranate peel powder on CCL₄-induced toxicity in rats. Normal control rats had serum urea nitrogen, creatinine, and uric acid values of 2.77±0.25, 20.1±1.23, and 0.41±0.02 mg/dL, in that order. Serum levels of creatinine, urea nitrogen, and uric acid were measured in the positive group (+ve) increased considerably to 3.87±0.40, 50.87, and 0.71 mg/dl, respectively (p < 0.05). Rats treated with POP had considerably lower levels relative to the positive control group in terms of uric acid, creatinine and urea. Group (5) treated with 6% POP showed steady improvement in renal function.

Rats with CisPt-induced AKI have considerably higher serum urea, creatinine, Hcy and kidney Hyp, lipid peroxidation, kidney GSH, NO, and TAC, while their control rats have significantly lower kidney GSH, NO, and TAC. After being treated with Au-NPs and fig extract, renal function improved with an effective ROS scavenging capacity, especially at a ratio of (3:2) Dogara, et al ., (2024)

According to Kumar et al. (2018), Compared to the thioacetamide-treated group, the group treated with Ficus Bengalensis Latex at a dose of 300 mg/kg b.w. and thioacetamide at a dose of 100 mg/kg b.w. exhibited a higher level of total protein (6.12 ± 0.11).

Table 2 demonstrated the effect of (PM) and fig on liver enzymes (ALT, AST and Alb) (U/L) in rats of the different experimental groups.

The results, as recorded in the Table 2, showed that there were no significant differences in ALT between the positive and negative control, while there were significant decreases in both 10 and 5%(PM) groups compared to the control group. On the other hand, there were no significant differences in AST of the different experimental groups, except the last group which contain 10 % PM and 10 % F($45, 44.20$ u/l) respectively.

Table (2) shows that treatment with CCL_4 resulted in a significant increase in the activity of alkaline phosphatase (ALP), compared to the negative control group. However, CCL_4 therapy resulted in a significant reduction in serum albumin levels when compared to the negative control group. Rats treated with pomegranate peel at all levels showed a substantial decrease in ALP, values when compared to the positive control group. Pomegranate peel significantly increased blood albumin levels at all levels, with no significant difference between the 5% and 10% levels compared to the negative control group. (ALP) levels increased significantly as compared to the positive control group.

Table (2): ALT , AST and Alb in rats fed on Pomegranate Molasses (PM) and Fig(F) of the different experimental groups after 6 wk.

Groups / Parameters	ALT (GPT) u/l	AST (GOT) u/l	Alb (mg/dl)
Negative Control	$44.50^{ab} \pm 0.5$	$42.50^{ab} \pm 2.5$	$3.40^{ab} \pm 0.10$
positive Control	$51.50^a \pm 2.5$	$51.00^a \pm 6.0$	$3.85^a \pm 0.05$
2.5%(PM)	$48.50^{ab} \pm 3.5$	$49.00^{ab} \pm 0.00$	$3.70^a \pm 0.10$
5%(PM)	$47.00^b \pm 1.0$	$47.50^{ab} \pm 1.5$	$3.55^a \pm 0.25$
10%(PM)	$45.50^b \pm 0.00$	$45.00^b \pm 2.0$	$3.05^b \pm 0.05$
2.5%F	$48.60^a \pm 5.98$	$48.00^{ab} \pm 2.92$	$3.56^{ab} \pm 0.07$
5% F	$46.00^a \pm 1.94$	$47.20^{ab} \pm 1.58$	$3.82^a \pm 0.06$
10% F	$45.00^b \pm 3.34$	$44.20^b \pm 1.65$	$3.24^b \pm 0.30$

Mean values in each row having different superscript (a, b, c) denote significant difference

ALT : (N: up to 40 U/L) AST : (N: up to 40 U/L) AST: Aspartate transaminase

ALT: Alanine transaminase

This finding are in agreement with Shima (2022) who showed that rats treated with pomegranate peel had significantly lower levels of ALP, total bilirubin, ALT, GGT, and AST compared to the control group. Regarding serum albumin levels, pomegranate peel at all levels, there was significant elevation, with no significant difference between the negative control group and the pomegranate peel groups at 4% and 6%. Total protein and globulin levels increased significantly compared to the positive control group.

Ali et al. (2021) found that CCl₄ intoxication significantly increased serum ALP, ALT, and AST levels compared to the control group. However, pomegranate peel (PPE) and its fractions significantly reduced these levels, indicating repair of hepatocyte destruction and preservation of cell membrane and hepatic architecture.

According to Foad et al. (2018), CCl₄ treatment significantly increased serum ALT, AST, and AIP levels, whereas serum total protein levels remained unchanged. Melo et al. (2015) found that rats with CCl₄ hepatic damage had higher levels of ALT and AST compared to the negative control group. El-Hadary and Hassanien (2016) found that CCl₄ treatment significantly increased the activity of ALP, ALT, and AST enzymes compared to the negative control group. However, protein parameters (A/G ratio, globulin, albumin, and total protein) decreased overall. According to Abdel-Rahman & Abd El-Megeid (2006) and Hanaa (2014), administering CCl₄ caused liver damage in mice, as measured by blood plasma AIP, AST, bilirubin, and ALT levels. However, POP therapy significantly improved these alterations.

The infected animal group showed higher levels of ALT, AST, and ALP compared to the control group. Pre-treatment with Ficus extract and PZQ showed the strongest hepatoprotective effect El-Shabasy, *et al.*, (2022).

Biochemical testing showed increased serum enzyme levels in the rifampicin-treated group in contrast to the group under authority, indicating liver injury. The group treated with Ficus carica extract showed a considerable reduction in SGPT and SGOT levels Gond & Khadabadi (2008)

Serum levels of ALP (132.6±8.40) were found to be lower in the groups treated with thioacetamide (dosage 100 mg/kg b.w.) and Ficus Bengalensis Latex (dose 300 mg/kg b.w.) than in the group treated with thioacetamide (182.4±5.20). Ficus Bengalensis Latex was found to be less effective than Carica Papaya Latex. The hepatoprotective

examination revealed that both latex significantly decreased the elevated blood parameter and boosted the rat hepatotoxin-induced drop in total protein level Kumar and others (2018).

Total flavonoid ,Total phenols and DPPH of PM and fig are shown in Table 3 .

Phenolic and flavonoid molecules are the most antioxidants, preventing oxidative cell damage and acting as anti-inflammatory, anti-thrombotic, and anti-allergic agents (Uchegbu *et al.*, 2016). The total flavonoid, total phenol, and DPPH levels in the Pomegranate powder plant(PM) and fig were determined and shown in Table 3.

The total flavonoid and total phenol, levels in the Pomegranate powder plant(PM) and fig were 35.29, 23.64 and 41.65, 18.96 ml / 100 mlgm ,respectively. Table (3) showed DPPH radical scavenging activity (%)

Table (3): Total flavonoid ,Total phenols and DPPH of Pomegranate Molasses (PM) and Fig (F)

Groups / Parameters	(PM)	Fig
Total flavonoid ml / 100 mg	35.29	41.65
Total phenols ml / 100 mg	23.64	18.96
DPPH%	63.21	59.83

concentration of the Pomegranate powder plant(PM) and fig it was recorded 63.21 and 59.83% ,respectively.

In this respect, Bakır *et al.*, (2015) discovered that the pomegranate extract's total phenolic content was 26.25 mg GAE/0.5 ml, while the amount of flavonoids was 31.50 mg/0.5 ml. A research by MI *et al.* (2000) shows the amount of phenolic compounds in pomegranate extract is double that of green tea (1029 mg/L).

Dogara, *et al.* , (2024) reported that highest amounts of DPPH (41.6%) and FRAP (8504 mg FeSO₄/kg DM) were found in fig seeds extracted with 50% (v/v) aqueous methanol (30). The DPPH experiment revealed that fresh figs had the highest levels of antioxidant activity.

Initial weight (g), final weight (g) and BWG (g) in rats of the different experimental groups after 6 weeks.were presented in Table 4.

All groups had a lower body weight but CCl₄ group rats had reduced more than a quarter of the mean body weight in contrast to the control group's. The animals fed with (2.5%, 5% PM) had a similar lower mean weight (23.5% of initial weight) while animals fed with (10% PM) had a

lower mean weight only (21% of Initial weight) which indicated that supplementation of PM along with CCl₄ resume the lost weight caused by CCl₄ as compared to that of control group.

Meanwhile, the CCl₄-treated group recorded the lowest body weight gain, as compared with all groups these may be due to loss of appetite and the acute hepatic damage spotted in rats intoxicated using CCl₄.

These outcomes are consistent with Shimaa (2022) who claimed that mice in the CCl₄ treatment group had lower body weights than the control group. It was discovered that rats given with pomegranate peel powder (POP) at 2%, 4%, and 6% had a substantial increase and protective effect in all nutritional parameters in contrast to the positive control group. Conversely, though POP at a level of 6% had the best protective potential against CCl₄ poisoning.

Table (4): Initial Weight (g), Final Weight (g) and BWG (g) in rats fed on Pomegranate Molasses(PM) and Fig(F) of the different experimental groups after 6 wk.

Groups / Parameters	Initial weight (g)	Final weight (g)	BWG (g)
Negative Control	183.25 ^a ± 22.29	139.50 ^a ± 28.54	-43.75 ^b ± 11.44
positive Control	184.25 ^a ± 32.99	135.00 ^a ± 17.64	-49.25 ^{ab} ± 0.18
2.5%(PM)	184.00 ^a ± 27.77	140.75 ^a ± 16.11	-43.25 ^{ab} ± 6.39
5%(PM)	163.00 ^a ± 21.78	124.75 ^a ± 18.57	-38.25 ^a ± 9.39
10%(PM)	174.50 ^a ± 24.44	137.75 ^a ± 32.58	-36.75 ^{ab} ± 5.61
2.5%F	200.20 ^a ± 6.34	145.80 ^a ± 10.05	-54.40 ^a ± 5.59
5% F	186.20 ^a ± 19.84	142.0 ^a ± 9.02	-44.20 ^{ab} ± 12.21
10% F	197.60 ^a ± 33.88	161.0 ^a ± 21.15	-36.6 ^b ± 14.90

Mean values in each row having different superscript (a, b, c) denote significant difference

Nemiche et al (2022) found that after one month of treatment with nickel chloride, there was no significant difference in these parameters compared to the control group. FCE administration resulted in a considerable ($p < 0.001$) increase in body weight (+24%) and gain (+91%) in the Ni + FC group, compared to the Ni group. The FC group gained significantly more body weight (+52%) than the untreated group ($p < 0.01$). Rats in the various experimental groups did not differ significantly in terms of liver weight or liver body weight ratio.

Table (5) showed Organs weight in rats of the different experimental groups after 6 wk.

Table(5) :Organs weight in rats fed on Pomegranate Molasses (PM) and Fig (F) of the different experimental groups after 6 wk.

Groups / Parameters	Liver	Kidney	Spleen	Heart
Negative Control	3.86 ^a ± 0.66	0.87 ^a ± 0.09	0.46 ^a ± 0.13	0.38 ^a ± 0.11
positive Control	3.75 ^a ± 0.93	0.81 ^a ± 0.18	0.45 ^a ± 0.06	0.41 ^a ± 0.04
2.5%(PM)	3.39 ^a ± 0.32	0.75 ^a ± 0.05	0.35 ^a ± 0.08	0.35 ^a ± 0.06
5%(PM)	3.70 ^a ± 1.09	0.76 ^a ± 0.17	0.38 ^a ± 0.09	0.37 ^a ± 0.15
10%(PM)	3.18 ^a ± 0.33	0.68 ^a ± 0.06	0.36 ^a ± 0.05	0.33 ^a ± 0.07
2.5%F	3.73 ^a ± 0.28	0.88 ^a ± 0.04	0.44 ^a ± 0.05	0.36 ^a ± 0.02
5% F	3.84 ^a ± 0.68	0.75 ^a ± 0.01	0.38 ^a ± 0.05	0.39 ^a ± 0.05
10% F	3.92 ^a ± 0.39	0.76 ^a ± 0.14	0.41 ^a ± 0.07	0.34 ^a ± 0.04

Mean values in each raw having different superscript (a, b, c) denote significant difference

There was no significant difference observed at organs weight in rats from each experimental groups after 6 wk.

In this respect, Dogara, et al ., (2024) mentioned that One of the biggest organs in the body and the primary location of metabolism and excretion is the liver. Injuries to this organ, which is crucial for eliminating toxins that are both naturally occurring and artificially introduced, can have detrimental effects on a person's health.

Effect of (PM) and fig on rats' hemoglobin, platelet count, hematocrit, MCV, MCHC%, and RBC count of the different experimental groups after 6 weeks presented in Table 6.

These changes included an increase in hemoglobin, an increase in RBC for animals fed on PM in all concentrations but hematocrit increased at high concentrations dosage of PM (5%, 10%). Which indicated that supplement of PM along with CCl₄ resume the anemic effect caused by CCl₄ as compared to that of control group.

Table 6: Effect of Pomegranate Molasses (PM) and Fig (F) on Hb, RBC count, Hematocrit, MCV, MCHC% and Platelets count of the different experimental groups after 6 wk.

Groups	Hb	RBC	Hematocrit	MCV	MCH	MCHCP	Platelets count
Variables	g/dl	Count	(PCV)%	fl	pg.	g/dl	sands
Negative Control	11.70 ^a ±0.30	4.46 ^a ±0.21	36.76 ^a ±0.32	88.00 ^a ±1.00	27.00 ^a ±0.20	32.00 ^a ±1.00	394.66 ^b ±1.52
Positive Control	10.46 ^c ±0.47	3.86 ^c ±0.15	35.00 ^b ±1.00	84.00 ^b ± 1.00	25.30 ^b ±0.61	30.30 ^a ±0.61	397.66 ^a ±1.52
2.5% (PM)	10.83 ^{bc} ±0.15	4.03 ^{bc} ±0.15	34.83 ^b ±0.15	84.30 ^b ±0.60	26.00 ^{ab} ±1.00	31.0 ^a ±1.00	377.33 ^d ±1.52
5%(PM)	11.13 ^{ab} ±0.32	4.03 ^{bc} ±0.15	35.43 ^b ±0.51	84.66 ^b ±1.52	27.00 ^a ±1.00	31.63 ^a ±1.18	312.00 ^e ±2.00
10%(PM)	11.46 ^a ±0.50	4.43 ^a ^b ±0.51	36.46 ^a ±0.50	85.00 ^b ±1.00	27.50 ^a ±0.50	32.00 ^a ±1.00	311.66 ^e ±1.52
2.5%F	10.3 ^c ±0.26	3.82 ^c ±0.11	34.81 ^b ±0.12	84.00 ^b ±1.00	25.30 ^b ±0.61	30.30 ^a ±0.61	398.75 ^a ±0.36
5% F	10.40 ^c ±0.26	3.95 ^c ±0.05	34.97 ^b ±0.14	85.00 ^b ±1.00	26.66 ^{ab} ±1.44	31.00 ^a ±1.00	387.29 ^c ±0.15
10% F	10.81 ^{bc} ±0.25	4.04 ^{bc} ±0.14	35.26 ^b ±0.25	87.03 ^a ±0.95	27.16 ^a ±0.9	31.21 ^a ±0.70	387.59 ^c ±0.20

Mean values in each row having different superscript (a, b, c) denote significant difference
The normal number of platelets 150 to 400 × 10⁹/L. Thousands/cmm

Soliman *et al.*, (2022) mentioned that Male albino rats were used to examine the effects of pomegranate molasses ethanolic extract on anemia induced by phenylhydrazine (PHZ). After administering PHZ, red blood cells (RBCs) dropped in number, while the mean cell volume, hematocrit, and hemoglobin concentration rose. The findings for concentration, reticulocyte count, leukocyte count, platelet count, and mean corpuscular hemoglobin (MCH) were all consistent.

Yıkımsı *et al.*, (2022) reported that Thermosonication treatment (TS-PJ) had better sensory qualities. (TS-PJ) led to the detection of increases in the element (Fe) The bioavailability of bioactive substances was better conserved by TS-PJ in an in vitro simulated gastrointestinal media Which indicates why hematological and other parameters improved .

SiO₂NPs, Al₂O₃NPs, and ZnONP treatment significantly decreased Hb (36.59%, 44.38%, and 49.07%, respectively), RBC count (11.16%, 22.68%, and 38.01%), MCV (9.59%, 12.03%, and 14.34%), MCH

(28.33%, 27.79%, and 29.78%, respectively), and MCHC (20.63%, 16.20%, and 17.68%). The corresponding platelet counts are 13.66%, 15.84%, and 19.39%. The FOD-SiO₂NPs, FOD-Al₂O₃NPs, and FOD-ZnONP-treated groups had higher Hct percentages, RBC counts, Hb concentrations, and platelet counts, but lower WBC counts, neutrophils, lymphocytes, and monocytes compared to the SiO₂NPs, Al₂O₃NPs, and ZnONP-treated groups. The administration of FOD-SiO₂NPs, FOD-Al₂O₃NPs, and FOD-ZnONP did not affect MCV, MCH, or MCHC levels in the blood compared to SiO₂NPs, Al₂O₃NPs, and ZnONP. Naji *et al.*, (2023).

Effect of (PM) and fig on rat WBC count, neutrophils, basophils, lymphocytes, monocytes, and eosinophils of the different experimental group after 6 weeks presented in table 7.

From table 7 we can noted that CCl₄ group rats had a decrease in WBC, neutrophils, lymphocytes Monocytes, and Eosinophils, as compared to that of control group. Therefore, our results suggest that the intake of PM improve antioxidant activity and heaptotoxicity recovery and CBC outcomes

Our findings concur with Soliman *et al.*, (2022) who found that Molasses given before PHZ reduced RBC anomalies, decreased MCH, leukocyte, platelet, and reticulocyte counts, and elevated RBC, hematocrit, and hemoglobin concentration.

Naji *et al.*, (2023) reported that SiO₂NPs, Al₂O₃NPs, and ZnONP treatment the blood samples from the experimental group showed a noteworthy rise in the percentages of WBC (19.39%, 22.43%, and 20.92%, respectively), neutrophils (26.35%, 32.57%, and 31.01%), lymphocytes (12.65%, 12.27%, and 14.15%, respectively), and monocytes (26.63%, 30.12%, and 32.66%, respectively). The FOD-SiO₂NPs, FOD-Al₂O₃NPs, and FOD-ZnONP-treated groups had higher Hct percentages, RBC counts, Hb concentrations, and platelet counts, but lower WBC counts, neutrophils, lymphocytes, and monocytes compared to the SiO₂NPs, Al₂O₃NPs, and ZnONP-treated groups. The administration of FOD-SiO₂NPs, FOD-Al₂O₃NPs, and FOD-ZnONP did not affect MCV, MCH, or MCHC levels in the blood compared to SiO₂NPs, Al₂O₃NPs, and ZnONP.

Table 7: Effect of Pomegranate Molasses (PM) and Fig(F) on WBC count, Lymphocytes, Monocytes, Eosinophils, and Neutrophils of the different experimental groups after 6 wk.

Groups	WBC count	Neutrophils	Lymphocytes	Monocytes	Eosinophils
Negative Control	8.80 ^{ab} ±0.20	24.00 ^a ±1.00	84.26 ^a ±0.64	6.00 ^a ±1.00	1.70 ^a ±0.62
Positive Control	7.61 ^d ±0.34	11.26 ^d ±0.64	69.00 ^d ±1.00	4.10 ^{cde} ±0.36	1.20 ^a ±0.20
2.5% (PM)	8.86 ^{ab} ±0.15	12.23 ^{cd} ±0.49	79.00 ^b ±1.00	4.13 ^c ±0.32	1.26 ^a ±0.25
5%(PM)	8.63 ^{bc} ±0.32	13.00 ^{cd} ±1.00	82.33 ^a ±1.52	4.26 ^{de} ±0.64	1.36 ^a ±0.55
10%(PM)	9.41 ^a ±0.52	17.00 ^b ±1.00	84.00 ^a ±1.00	4.16 ^{de} ±0.20	1.50 ^a ±0.50
2.5%F	7.68 ^d ±0.27	12.33 ^{cd} ±0.58	69.11 ^d ±1.01	4.29 ^{bcd} ±0.32	1.33 ^a ±0.14
5% F	8.01 ^{cd} ±0.33	14.00 ^c ±2.0	71.50 ^c ±1.80	5.07 ^{abc} ±0.89	1.24 ^a ±0.02
10% F	8.53 ^{bc} ±0.56	13.03 ^{cd} ±0.95	77.33 ^b ±2.08	5.29 ^{ab} ±0.65	1.47 ^a ±0.19

Mean values in each raw having different superscript (a, b, c) denote significant difference

Histopathological Results

Control negative group showed There were no histological changes in the liver, and the hepatic parenchyma showed normal blood sinusoids and healthy hepatocytes (Fig. 1).

Group II (control positive group) showed diffuse liver alterations in the form of multifocal areas of degenerated and swelled hepatocytes which appeared vacuolated with eosinophilic cytoplasmic granules (Fig. 2).

Group III (low dose diet group) showed general improvement in all the examined tissues than the control positive group, liver reported improvement in the degenerated hepatocytes to become apparently normal (Fig. 3).

Group IV (high dose treated group) showed general improvement in all the examined tissues than the low dose diet group, liver reported complete regression in the degenerated hepatocytes which become fully normal and more improved than low dose diet group (Fig. 4).

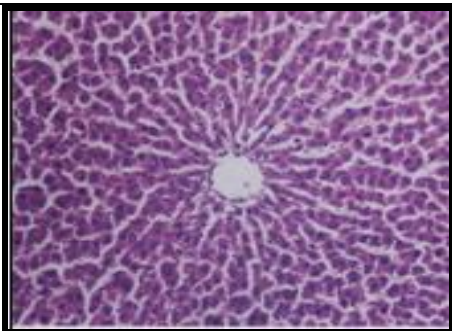


Fig. (1): Liver of negative control group, untreated rat showing the normal histology of hepatic lobule. (H and E X 200)

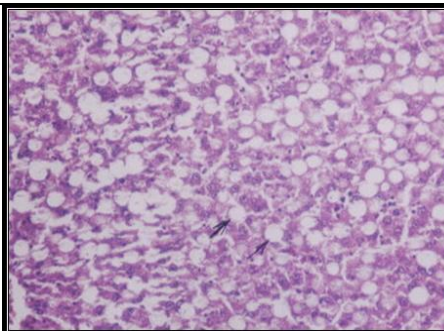


Fig. (2): Liver of rat from positive control group (CCL₄), showing vacuolar degeneration of hepatocytes with signet ring appearance of hepatocytes. (H and E X 200)

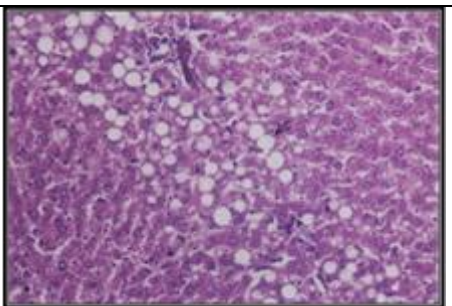


Fig. (3): Liver of rat from group (3) showing vacuolar degeneration of some hepatocytes

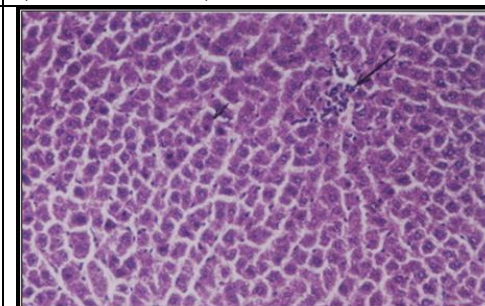


Fig. (4): Liver of rat from group (4), showing necrosis of sporadic hepatocytes (small arrow) associated with sinusoidal leukocytosis (large arrow). (H and E X 200)

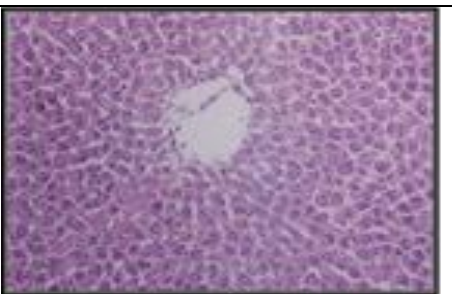


Fig. (5): Liver of rat from group (5) showing kupffer cell activation. (H and E X 200)

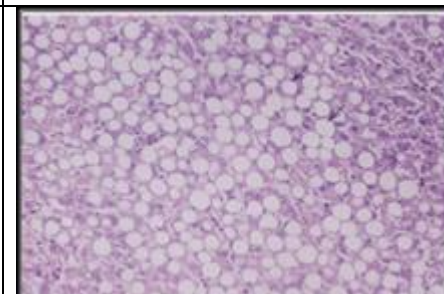


Fig. (6): Liver of rat from group (6) showing vacuolar degeneration of hepatocytes. (H and E X 200)

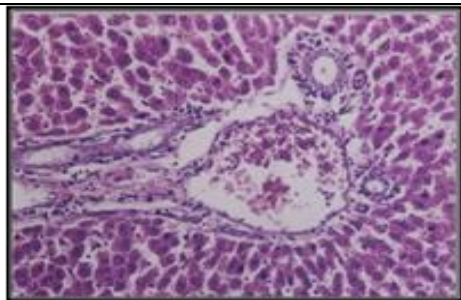


Fig. (7): Liver of rat from group (7) showing few leucocytic cells infiltrating the portal area. (H and E X 200)

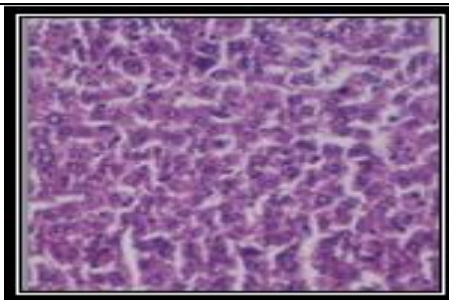


Fig. (8): Liver of rat from group (8) showing few sinusoidal leukocytosis. (H and E X 200)

Effects of date palm fruit extract (FOD) and olive oil mixed with fig fruit extract on Heart Histopathology in rats Administered with SiO₂NPs, Al₂O₃NPs, ZnONPs over a period of 75 days. The morphological appearance of the control heart tissue was normal. Nevertheless, the NP-administered groups that received antioxidant treatment (FOD-SiO₂NPs, FOD-Al₂O₃NPs, and FODZnONPs) showed significantly improved histopathological characteristics in the heart tissues as compared to the nonantioxidant-treated NP-administered groups (SiO₂NPs, Al₂O₃NPs, and ZnONPs, respectively) Naji *et al.*, (2023)

In addition , NP groups treated with antioxidants showed considerably improved Comparing histopathological characteristics to non-treated NP groups. FOD treatment protects heart tissues by reducing or preventing lipid and protein oxidation through free radical scavenging.

Conclusion

As a result, our findings imply that consuming pomegranate molasses (PM) or fig improves antioxidant activity, hepatotoxicity recovery, and CBC outcomes. Additionally, they can protect against CCL₄-induced blood poisoning and anemia, making it a possible natural therapy alternative. More research is needed on humans.

References

- Abdel-Aty, A. M., Hamed, M. B., Salama, W. H., Ali, M. M., Fahmy, A. S., & Mohamed, S. A. (2019). Ficus carica, Ficus sycomorus and Euphorbia tirucalli latex extracts: phytochemical screening, antioxidant and cytotoxic properties. *Biocatalysis and Agricultural Biotechnology*, 20, 101199.
- Abd Elmonem, H. A. (2014). Assessment the effect of pomegranate molasses against diazinon toxicity in male rats. *IOSR Journal of Environmental Science, Toxicology and Food Technology*, 8(2), 135-141.
- Abdel Moneim, A. E. (2012). Evaluating the potential role of pomegranate peel in aluminum-induced oxidative stress and histopathological alterations in brain of female rats. *Biological trace element research*, 150, 328-336.
- Abdel-Rahman, R., Ghoneimy, E., Abdel-Wahab, A., Eldeeb, N., Salem, M., Salama, E., & Ahmed, T. (2021). The therapeutic effects of Ficus carica extract as antioxidant and anticancer agent. *South African Journal of Botany*, 141, 273-277.
- Abdel-Rahman, M. K., & Abd El-Megeid, A. A. (2006). Hepatoprotective effect of soapworts (*Saponaria officinalis*), pomegranate peel (*Punica granatum* L) and cloves (*Syzygium aromaticum* linn) on mice with CCl₄ hepatic intoxication. *World journal of chemistry*, 1(1), 41-46.
- Afaq, F., Saleem, M., Krueger, C. G., Reed, J. D., & Mukhtar, H. (2005). Anthocyanin-and hydrolyzable tannin-rich pomegranate fruit extract modulates MAPK and NF-κB pathways and inhibits skin tumorigenesis in CD-1 mice. *International journal of cancer*, 113(3), 423-433.
- Aghel, N., Kalantari, H., & Hezazadeh, S. (2010). Hepatoprotective effect of Ficus carica leaf extract on mice intoxicated with carbon tetrachloride. *Iranian Journal of Pharmaceutical Research*, 10, 63-67.
- Agilent Application Note, Publication number 5991-3801EN, 2014
- Ajaikumar, K. B., Asheef, M., Babu, B. H., & Padikkala, J. (2005). The inhibition of gastric mucosal injury by Punica granatum L.(pomegranate) methanolic extract. *Journal of ethnopharmacology*, 96(1-2), 171-176.

- Akhtar, N., Khan, N. M., Ashruf, O. S., & Haqqi, T. M. (2017). Inhibition of cartilage degradation and suppression of PGE2 and MMPs expression by pomegranate fruit extract in a model of posttraumatic osteoarthritis. *Nutrition*, 33, 1-13.
- Ali, H., Jahan, A., Samrana, S., Ali, A., Ali, S., Kabir, N., ... & Kalim, M. (2021). Hepatoprotective potential of pomegranate in curbing the incidence of acute liver injury by alleviating oxidative stress and inflammatory response. *Frontiers in Pharmacology*, 12, 694607.
- Ali, B., Mujeeb, M., Aeri, V., Mir, S. R., Faiyazuddin, M., & Shakeel, F. (2012). Anti-inflammatory and antioxidant activity of *Ficus carica* Linn. leaves. *Natural product research*, 26(5), 460-465.
- Al-Snafi, A. E. (2017). Nutritional and pharmacological importance of *Ficus carica* – A review. *IOSR Journal of Pharmacy (IOSRPHR)*, 07, 33-48.
- Álvarez-Cervantes, P., Cancino-Díaz, J. C., Fabela-Illescas, H. E., Cariño-Cortés, R., López-Villegas, E. O., Ariza-Ortega, J. A., ... & Betanzos-Cabrera, G. (2021). Spray-drying microencapsulation of pomegranate juice increases its antioxidant activity after in vitro digestion. *International Journal of Food Science & Technology*, 56(10), 5089-5096.
- Al-Marazeeq K. M., Abdullah M. A and Angor M. M.(2017). Characterization and Sensory Evaluation of Pomegranate Molasses Fortified with Wheat Germ. *Advance Journal of Food Science and Technology* 13(4): 178-181.
- Amessis-Ouchemoukh, N., Ouchemoukh, S., Meziat, N., Idiri, Y., Hernanz, D., Stinco, C. M & Luis, J. (2017). Bioactive metabolites involved in the antioxidant, anticancer and anticalpain activities of *Ficus carica* L., *Ceratonia siliqua* L. and *Quercus ilex* L. extracts. *Industrial Crops and Products*, 95, 6-17.
- Ateşşahin, A., Karahan, I., Yilmaz, S., Çeribaşı, A. O., & Princci, I. (2003). The effect of manganese chloride on gentamicin-induced nephrotoxicity in rats. *Pharmacological research*, 48(6), 637-642.
- Badgujar, S. B., Patel, V. V., Bandivdekar, A. H., & Mahajan, R. T. (2014). Traditional uses, phytochemistry and pharmacology of *Ficus carica* : A review. *Pharmaceutical Biology*, 52, 1-17.

- Bailey, N. T. (1995). *Statistical methods in biology*. Cambridge university press.
- Bancroft, J. D., Stevens, A., & Turner, D. R. (1996). *Theory and Practice of Histological Techniques*, 4th edn (New York, Churchill Livingstone).
- Bakır, S., Yazgan, Ü. C., İbiloğlu, İ., Elbey, B., Kızıl, M., & Kelle, M. (2015). The protective effect of pomegranate extract against cisplatin toxicity in rat liver and kidney tissue. *Archives of Physiology and Biochemistry*, 121(4), 152-156.
- Barolo, M. I., Ruiz Mostacero, N., & López, S. N. (2014). *Ficus carica L. (Moraceae): An ancient source of food and health*. *Food Chemistry*.
- Brand-Williams, W.; Cuvelier, M.E.; Berset, C. Use of a free-radical method to evaluate antioxidant activity. *LWT Food Sci. Technol.* (1995) .28, 25–30.
- Boyacıoğlu, O., Kara, B., Tecimen, S., Kılıç, M., Delibaş, M., Erdoğan, R., Özdemir, E., Bahadır, A., & Örenay-Boyacıoğlu, S. (2021). Antiproliferative effect of *Ficus carica* latex on cancer cell lines is not solely linked to peroxidase-like activity of ficin. *European Journal of Integrative Medicine*, 45, 101348.
- Burtis, C. A., & Ashwood, E. R. (1999). *Tietz textbook of clinical chemistry*. Philadelphia, 1999, 1654-5.
- Chauhan, A., & Tanwar, B. (2015). Influence of processing on physicochemical, nutritional and phytochemical composition of *Ficus carica* (fig) fruit. *Research Journal of Pharmaceutical, Biological and Chemical Sciences Influence*, 6, 1474–1489.
- Ciavarella, C., Motta, I., Valente, S., & Pasquinelli, G. (2020). Pharmacological (or synthetic) and nutritional agonists of PPAR- γ as candidates for cytokine storm modulation in COVID-19 disease. *Molecules*, 25(9), 2076.
- Delanghe, J. R., & Speeckaert, M. M. (2011). Creatinine determination according to Jaffe—what does it stand for?. *Nephrology Dialysis Transplantation Plus*, 4(2), 83-86.
- Dogara, A. M., Hama, H. A., & Ozdemir, D. (2024). Taxonomy, traditional uses and biological activity of *Ficus carica L.*(Moraceae): A review. *Plant Science Today*, 11(2).

- Dueñas, M., Pérez-Alonso, J. J., Santos-Buelga, C., & Escribano-Bailón, T. (2008). Anthocyanin composition in fig (*Ficus carica* L.). *Journal of Food Composition and Analysis*, 21, 107–115.
- El-Hadary, A. E., & Ramadan Hassanien, M. F. (2016). Hepatoprotective effect of cold-pressed *Syzygium aromaticum* oil against carbon tetrachloride (CCl₄)-induced hepatotoxicity in rats. *Pharmaceutical biology*, 54(8), 1364-1372.
- El-Sayed, S. M., El-Naggar, M. E., Hussein, J., Medhat, D., & El-Banna, M. (2019). Effect of *Ficus carica* L. leaves extract loaded gold nanoparticles against cisplatin-induced acute kidney injury. *Colloids and Surfaces B: Biointerfaces*, 184, 110465.
- El-Shabasy, E. A., El-Morsy, S. M., & Amer, M. A. (2022). Hepatoprotective, Antioxidant and Immunological Activities of the Ethanolic *Ficus carica* Leave Extract and/or PZQ in *Schistosoma mansoni* Infected Mice. *Open Access Library Journal*, 9(10), 1-17.
- Feng, X., Yang, Q., Wang, C., Tong, W., & Xu, W. (2020). Punicalagin exerts protective effects against ankylosing spondylitis by regulating NF-κB-TH17/JAK2/STAT3 signaling and oxidative stress. *BioMed Research International*, 2020.
- Foad, M. A., Kamel, A. H., & Abd El-Monem, D. D. (2018). The protective effect of N-acetyl cysteine against carbon tetrachloride toxicity in rats. *The Journal of Basic and Applied Zoology*, 79, 1-13.
- Fossati, P., Prencipe, L., & Berti, G. (1980). Use of 3, 5-dichloro-2-hydroxybenzenesulfonic acid/4-aminophenazone chromogenic system in direct enzymic assay of uric acid in serum and urine. *Clinical chemistry*, 26(2), 227-231.
- George, T. T., Oyenih, A. B., Oyenih, O. R., & Obilana, A. O. (2023). Composition and Health-Promoting Effects of fig (*Ficus carica*) Extracts. In *fig (Ficus carica): Production, Processing, and Properties* (pp. 561-578). Cham: Springer International Publishing.
- Gond, N. Y., & Khadabadi, S. S. (2008). Hepatoprotective activity of *Ficus carica* leaf extract on rifampicin-induced hepatic damage in rats. *Indian journal of pharmaceutical sciences*, 70(3), 364.
- Gurung, A. B., Ali, M. A., Lee, J., Farah, M. A., & Al-Anazi, K. M. (2021). Molecular docking and dynamics simulation study of bioactive compounds from *Ficus carica* L. with important anticancer drug targets. *Plos one*, 16(7), e0254035.
- Haghi, M. E., Dehghan, G., Banihabib, N., Zare, S., Mikaili, P., & Panahi, F. (2014). Protective effects of *Cornus mas* fruit extract on carbon tetrachloride induced nephrotoxicity in rats. *Indian journal of nephrology*, 24(5), 291-296.

- Hanaa, F. El. , M . (2014). Antioxidant potential effect of pomegranate molasses to chicken burger in a rats model of hyperuricemia. *The New Egyptian Journal of Medicine*. Egypt 43: 14-28.
- Hensley, K., Robinson, K. A., Gabbita, S. P., Salsman, S., & Floyd, R. A. (2000). Reactive oxygen species, cell signaling, and cell injury. *Free Radical Biology and Medicine*, 28(10), 1456-1462.
- Hou, C., Zhang, W., Li, J., Du, L., Lv, O., Zhao, S., & Li, J. (2019). Beneficial effects of pomegranate on lipid metabolism in metabolic disorders. *Molecular nutrition & food research*, 63(16), 1800773.
- Howell, A. B., & D'Souza, D. H. (2013). *The pomegranate: effects on bacteria and viruses that influence human health. Evidence-Based Complementary and Alternative Medicine*, 2013.
- Jacob, S. J. P., Prasad, V. S., Sivasankar, S., & Muralidharan, P. (2017). Biosynthesis of silver nanoparticles using dried fruit extract of *Ficus carica*-Screening for its anticancer activity and toxicity in animal models. *Food and Chemical Toxicology*, 109, 951-956.
- Jemal, A., Siegel, R., Ward, E., Murray, T., Xu, J., & Thun, M. J. (2007). Cancer statistics, 2007. *CA: a cancer journal for clinicians*, 57(1), 43-66.
- Jeong, W. S., & Lachance, P. A. (2001). Phytosterols and fatty acids in fig (*Ficus carica*, var. Mission) fruit and tree components. *Journal of Food Science*, 66, 278–281.
- Kandyliis, P., & Kokkinomagoulos, E. (2020). Food applications and potential health benefits of pomegranate and its derivatives. *Foods*, 9(2), 122.
- Khan, R. A., Khan, M. R., & Sahreen, S. (2012). CCl 4-induced hepatotoxicity: protective effect of rutin on p53, CYP2E1 and the antioxidative status in rat. *BMC complementary and alternative medicine*, 12, 1-6.
- Khan, M., Sarwar, A., Adeel, M., & Wahab, M. (2011). Nutritional evaluation of *Ficus carica* indigenous to Pakistan. *African Journal of Food, Agriculture, Nutrition and Development*, 11.
- Kumar, S., & Das, A. (2022). Elucidation of natural compounds Gallic acid and Shikonin for the treatment of HNSC cancer by targeting immune suppressor and tumour progressor genes. *Vegetos*, 35(4), 880-894.

- Kumar, Y., Gautam, G., & Mishra, P. (2018). Evaluation of hepatoprotective activity of *Carica papaya* and *Ficus bengalensis* latex on thioacetamide induced hepatotoxicity. *Int J Adv Res*, 6, 294-9.
- Li, X., Chen, Y., Ye, W., Tao, X., Zhu, J., Wu, S., & Lou, L. (2015). Experimental research Blockade of CCN4 attenuates CCl₄-induced liver fibrosis. *Archives of medical science*, 11(3), 647-653.
- Makoolati, Z., Bahrami, H., Zamanzadeh, Z., Mahaldashtian, M., Moulazadeh, A., Ebrahimi, L., & Naghdi, M. (2022). Efficacy of *Ficus carica* leaf extract on morphological and molecular behavior of mice germ stem cells. *Animal Reproduction*, 19, e20220036.
- Mansoor, H. U. H., Ahmed, A., & Rasool, F. (2023). The inhibitory potential of chemical constituents of *Ficus carica* targeting interleukin-6 (IL-6) mediated inflammation. *Cell Biochemistry and Function*, 41(5), 573-589.
- Mahmoudi, S., Khali, M., Benkhaled, A., Boucetta, I., Dahmani, Y., Attallah, Z., & Belbraouet, S. (2018). Fresh figs (*Ficus carica* L.): Pomological characteristics, nutritional value, and phytochemical properties. *European Journal of Horticultural Science*, 83, 104–113.
- MI, G. (2000). Tomas-Barberan FA. Hess-Pierce B. Holcroft DM. Kader AA. Antioxidant activity of pomegranate juice and its relationship with phenolic composition and processing. *J Agric Food Chem*, 48, 4581-4589.
- Melo, I. L. P. D., Silva, A. M. O., Carvalho, E. B. T., Yoshime, L. T., Mancini, D. A. P., & Mancini-Filho, J. (2015). Effect of Pomegranate (*Punica granatum* L.) Seed Oil on Markers of Oxidative Stress Induced by Carbon Tetra-chloride in Wistar rats. *Int J Food Sci Nutr Diet*, 5, 1-8.
- Moradnia, M., Mohammadkhani, N., Azizi, B., Mohammadi, M., Ebrahimpour, S., Tabatabaei-Malazy, O., ... & Ale-Ebrahim, M. (2024). The Power of *Punica granatum*: A Natural Remedy for Oxidative Stress and Inflammation; a narrative review. *Journal of Ethnopharmacology*, 118243.
- Morovati, M. R., Ghanbari-Movahed, M., Barton, E. M., Farzaei, M. H., & Bishayee, A. (2022). A systematic review on potential anticancer activities of *Ficus carica* L. with focus on cellular and molecular mechanisms. *Phytomedicine*, 105, 154333.

- Naji, R. M., Bashandy, M. A., & Fathy, A. H. (2023). Ameliorative effects of some natural antioxidants against blood and cardiovascular toxicity of oral subchronic exposure to silicon dioxide, aluminum oxide, or zinc oxide nanoparticles in wistar rats. *International Journal of Food Science*, 2023(1), 8373406.
- Nakilcioğlu-Taş, E., & Ötleş, S. (2021). Influence of extraction solvents on the polyphenol contents, compositions, and antioxidant capacities of fig (*Ficus carica* L.) seeds. *Anais da Academia Brasileira de Ciências*, 93, 1–11.
- Nemiche, S., Ait Hamadouche, N., Nemmiche, S., Fauconnier, M. L., & Tou, A. (2022). Ameliorative or corrective effects of fig “*Ficus carica*” extract on nickel-induced hepatotoxicity in Wistar rats. *Toxicological Research*, 38(3), 311-321.
- Pal, I. (2020). A comprehensive review on *Ficus carica* L. – An unexplored medicinal plant. *International Journal of Advanced Research*, 8, 876–881.
- Passmore, R., & Eastwood, M. A. (1986). *Davidson and Passmore human nutrition and dietetics* (No. Ed. 8). Churchill Livingstone.
- Peñalver-Mellado, M., Silva-Fuentes, F., Villar, A., Mula, A., & Zangara, A. (2023). In Vitro Anti-Inflammatory Potential of Pomegranate Extract (Pomanox®) in a Reconstituted Human Corneal Epithelium Model. *Journal of Clinical & Translational Ophthalmology*, 1(2), 52-60.
- Raffaele, M., Greish, K., Vanella, L., Carota, G., Bahman, F., Bindayna, K. M., ... & Sorrenti, V. (2021). Potential Health Benefits of a Pomegranate Extract, Rich in Phenolic Compounds, in Intestinal Inflammation. *Current Nutrition & Food Science*, 17(8), 833-843.
- Reeves, P. G., Nielsen, F. H., & Fahey Jr, G. C. (1993). AIN-93 purified diets for laboratory rodents: final report of the American Institute of Nutrition ad hoc writing committee on the reformulation of the AIN-76A rodent diet. *The Journal of nutrition*, 123(11), 1939-1951.
- Rosenblat, M., Volkova, N., Borochoy-Neori, H., Judeinstein, S., & Aviram, M. (2015). Anti-atherogenic properties of date vs. pomegranate polyphenols: the benefits of the combination. *Food & Function*, 6(5), 1496-1509.

- Sadia, H., Ahmad, M., Sultana, S., Abdullah, A. Z., Teong, L. K., Zafar, M., & Bano, A. (2014). Nutrient and mineral assessment of edible wild fig and mulberry fruits. *Fruits*, 69, 159–166.
- Seeram, N. P., Henning, S. M., Zhang, Y., Suchard, M., Li, Z., & Heber, D. (2006). Pomegranate juice ellagitannin metabolites are present in human plasma and some persist in urine for up to 48 hours. *The Journal of nutrition*, 136(10), 2481-2485.
- Shahzad Shirazi, M., Moridi Farimani, M., Foroumadi, A., Ghanemi, K., Benaglia, M., & Makvandi, P. (2022). Bioengineered synthesis of phytochemical-adorned green silver oxide (Ag₂O) nanoparticles via *Mentha pulegium* and *Ficus carica* extracts with high antioxidant, antibacterial, and antifungal activities. *Scientific Reports*, 12(1), 21509.
- Shimada, K., Fujikawa, K., Yahara, K., & Nakamura, T. (1992). Antioxidative properties of xanthan on the autoxidation of soybean oil in cyclodextrin emulsion. *Journal of agricultural and food chemistry*, 40(6), 945-948.
- Shimaa, F.,A. ,E. ,G. (2022) Hepatoprotective Effect of Pomegranate (*Punica granatum L*) Peels powder against Carbon Tetrachloride (CCl₄)-Induced Hepatotoxicity in rats.2331-2356 ,(66) , Research Journal Specific Education Faculty of Specific Education Mansoura University.
- Sohrab, G., Ebrahimof, S., Sotoudeh, G., Neyestani, T. R., Angoorani, P., Hedayati, M., & Siasi, F. (2017). Effects of pomegranate juice consumption on oxidative stress in patients with type 2 diabetes: a single-blind, randomized clinical trial. *International journal of food sciences and nutrition*, 68(2), 249-255.
- Sohrab, G., Angoorani, P., Tohidi, M., Tabibi, H., Kimiagar, M., & Nasrollahzadeh, J. (2015). Pomegranate (*Punicagranatum*) juice decreases lipid peroxidation, but has no effect on plasma advanced glycated end-products in adults with type 2 diabetes: a randomized double-blind clinical trial. *Food & nutrition research*, 59(1), 28551.
- Soliman, N. A. A., Mansour, S. W., Ammar, M. A. M., Hassan, N. A., Hamad, R., & Ammar, M. (2022). Using LCMS/MS, new pomegranate molasses compounds were examined for their effects on anemia brought on by phenylhydrazine.z
- Stefanou, V., Papatheodorou, S., Tsakni, A., Lougovois, V., Talelli, A., Panourgias, G., ... & Tsaknis, I. (2020). Anti-Inflammatory Properties of Pomegranate. *International Journal of Advanced Research in Microbiology and Immunology*, 2(1), 1-13.

- Suručić, R., Tubić, B., Stojiljković, M. P., Djuric, D. M., Travar, M., Grabež, M., ... & Škrbić, R. (2021). Computational study of pomegranate peel extract polyphenols as potential inhibitors of SARS-CoV-2 virus internalization. *Molecular and cellular biochemistry*, 476, 1179-1193.
- Tomás-Barberán, F. A., González-Sarriás, A., García-Villalba, R., Núñez-Sánchez, M. A., Selma, M. V., García-Conesa, M. T., & Espín, J. C. (2017). Urolithins, the rescue of “old” metabolites to understand a “new” concept: Metabotypes as a nexus among phenolic metabolism, microbiota dysbiosis, and host health status. *Molecular nutrition & food research*, 61(1), 1500901.
- Türk, G., Sönmez, M., Aydin, M., Yüce, A., Gür, S., Yüksel, M., ... & Aksoy, H. (2008). Effects of pomegranate juice consumption on sperm quality, spermatogenic cell density, antioxidant activity and testosterone level in male rats. *Clinical nutrition*, 27(2), 289-296.
- Uchegbu, R. I., Ahuchaogu, A. A., Mbadiugha, C. N., Amanze, K. O., Igara, C. E., Iwu, I. C., & Ikechukwu-Nwankwo, P. C. (2016). Antioxidant, anti-inflammatory and antibacterial activities of the seeds of *Mucuna pruriens* (UTILIS). *Am. Chem. Sci. J*, 13, 1-8.
- Veberic, R., & Mikulic-Petkovsek, M. (2015). Phytochemical composition of common fig (*Ficus carica* L.) cultivars. In *Nutritional composition of fruit cultivars* (pp. 235–255). Elsevier Inc.
- Verma, I., Gupta, R. K., Rajinder, C., & Gupta, K. (2015). Estimation of phytochemical, nutritional, antioxidant and antibacterial activity of dried fruit of sacred figs (*Ficus religiosa*) and formulation of value-added product (Hard Candy). *Journal of Pharmacognosy and Phytochemistry JPP*, 4, 257–267.
- Vora, J. D., Vora, D., Pednekar, S. R., Patwardhan, A. U., & Shaikh, S. (2017). Biochemical, organoleptic assessment of fig (*Ficus carica*). *IOSR Journal of Biotechnology and Biochemistry*, 03, 95–104.
- Vučić, V., Grabež, M., Trchounian, A., & Arsić, A. (2019). Composition and potential health benefits of pomegranate: a review. *Current pharmaceutical design*, 25(16), 1817-1827.
- Yıkımsı, S., Ozer, H., Levent, O., Çöl, B. G., & Erdal, B. (2022). Effect of thermosonication and thermal treatments on antidiabetic, antihypertensive, mineral elements and in vitro bioaccessibility of bioactive compounds in freshly squeezed pomegranate juice. *Journal of Food Measurement and Characterization*, 16(4), 3023-3041.

- Young, D. S., & Friedman, R. B. (2001). Effects of disease on clinical laboratory tests. (No Title).
- Wenger, C., (1984): Alkaline phosphatase. In: Clinical chemistry: theory, methods and practice. L. A. Kaplan and A. J. Pesce (Eds). C.V. Mosby Co, St. Louis, pp. 1094–1098.
- Wojdyło, A., Nowicka, P., Carbonell-Barrachina, Á. A., & Hernández, F. (2016). Phenolic compounds, antioxidant and antidiabetic activity of different cultivars of *Ficus carica* L. fruits. *Journal of Functional Foods*, 25, 421–432.
- Xie Y., Morikawa T. & Ninamiya K. (2008): Medicinal flowers. New tarazstrane type tritrepone, punicanolic acid with tumor necrosis factor-alpha inhibitory activity from the flowers of *punica granatum*. *Chem. Pharm. Bull.* 56(11): 1628-1631.
- Zarei, M., Azizi, M., & Bashir-Sadr, Z. (2011). Evaluation of physicochemical characteristics of pomegranate (*Punica granatum* L.) fruit during ripening. *Fruits*, 66(2), 121-129.
- Žilić, S., Serpen, A., Akıllıoğlu, G., Janković, M., & Gökmen, V. (2012). Distributions of phenolic compounds, yellow pigments and oxidative enzymes in wheat grains and their relation to antioxidant capacity of bran and debranned flour. *Journal of cereal science*, 56(3), 652-658.

التأثير العلاجي لدبس الرمان والتين على الفئران المصابة بالتسمم الكبدي برابع كلوريد الكربون

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الملخص

تمت دراسة التأثير الوقائي المحتمل لدبس الرمان والتين ضد التسمم الكبدي الناجم عن رابع كلوريد الكربون (CCl_4) في ذكور الفئران. وقد تبين أن دبس الرمان والتين يحتويان على العديد من المركبات الفينولية والفلافونويد. أجريت الدراسة على ثمانى مجموعات في كل مجموعة (6) فئران؛ المجموعة (1) الضابطة السالبة (طبيعي)، في حين تم إعطاء فئران المجموعات الأخرى حقنة تحت الجلد من رابع كلوريد الكربون (CCl_4) مرتين أسبوعياً لمدة ستة أسابيع للحث على تسمم الخلايا الكبدية. تركت المجموعة (2) كمجموعة ضابطة موجبة، بينما أعطيت باقي المجموعات دبس الرمان أو التين المجفف بنسبة (2.5%، 5%، 10%) لمدة 6 أسابيع على التوالي. وفي نهاية التجربة تم أخذ عينات الدم للتحليل البيوكيميائي. أظهرت النتائج أن الفئران المصابة بتسمم الخلايا الكبدية لديها زيادة معنوية في مستويات AST، ALT، البروتين الكلى، الكرياتينين، ونيتروجين اليوريا في الدم، مقارنة بالمجموعة الضابطة الطبيعية. أدى إعطاء (2.5%، 5%، 10%) من الرمان والتين المجفف إلى الحفاظ على الكبدو تسبب في انخفاض كبير في مستويات AST و ALT والبروتين الكلى والكرياتينين ونيتروجين يوريا في الدم بينما وكانت نسبة الزيادة في الهيموجلوبين وكريات الدم الحمراء أكثر في الفئران التى تناولت دبس الرمان خاصة المجموعة التى تناولته بتركيز (10%). خلصت هذه الدراسة إلى أن دبس الرمان والتين المجفف يمكن أن يكون لهما تأثير وقائي من السمية الكبدية في الفئران والتأثير على فقر الدم الناجم عن ال CCl_4 ، لذلك توصي هذه الدراسة بزيادة تناول دبس الرمان والتين المجفف كإجراء وقائي للمرضى الذين يعانون من أمراض الكبد والكلى.

الكلمات المفتاحية: الرمان؛ التين؛ رابع كلوريد الكربون؛ السمية الكبدية؛ إنزيمات الكبد؛ وظائف الكلى؛ الفئران.