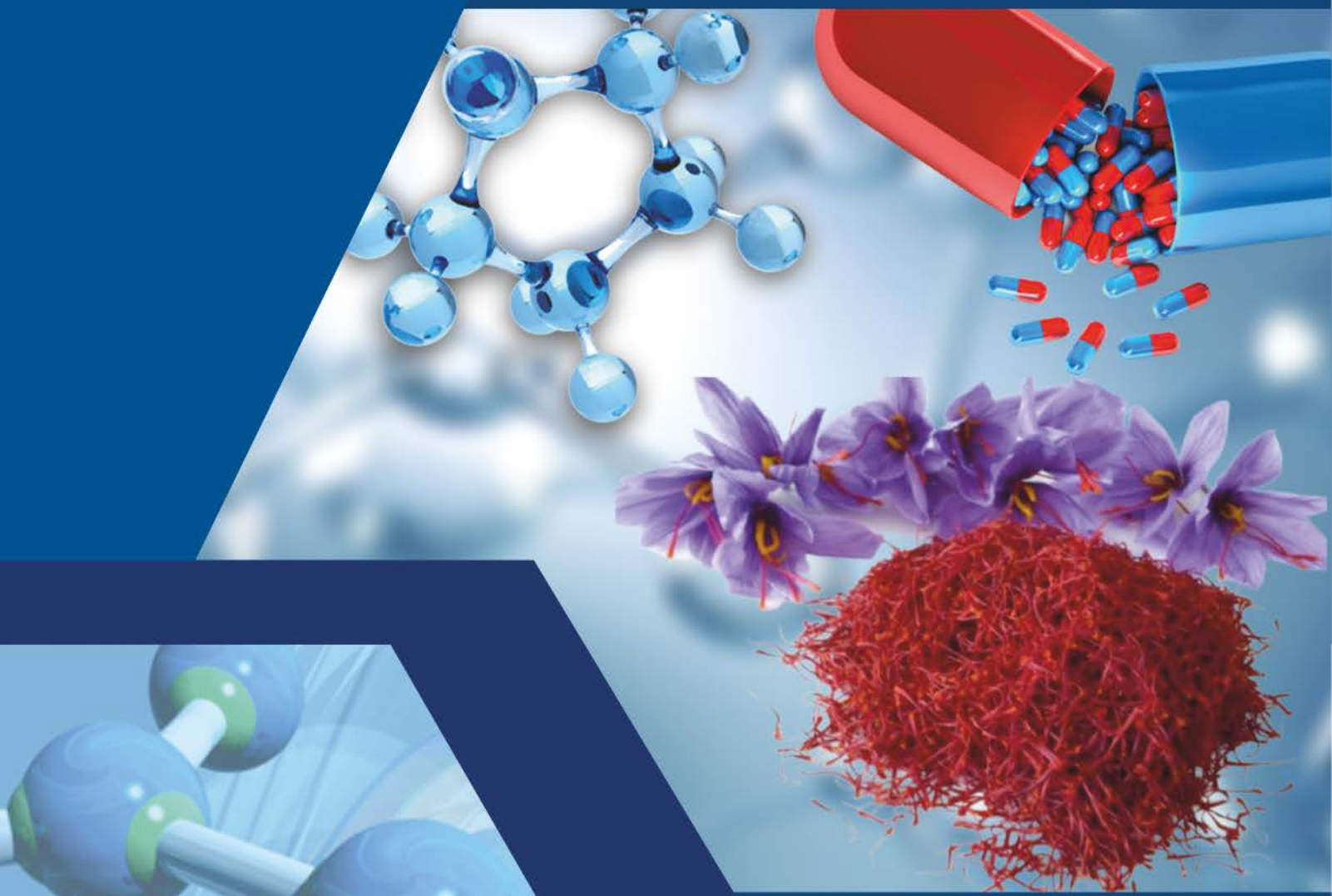
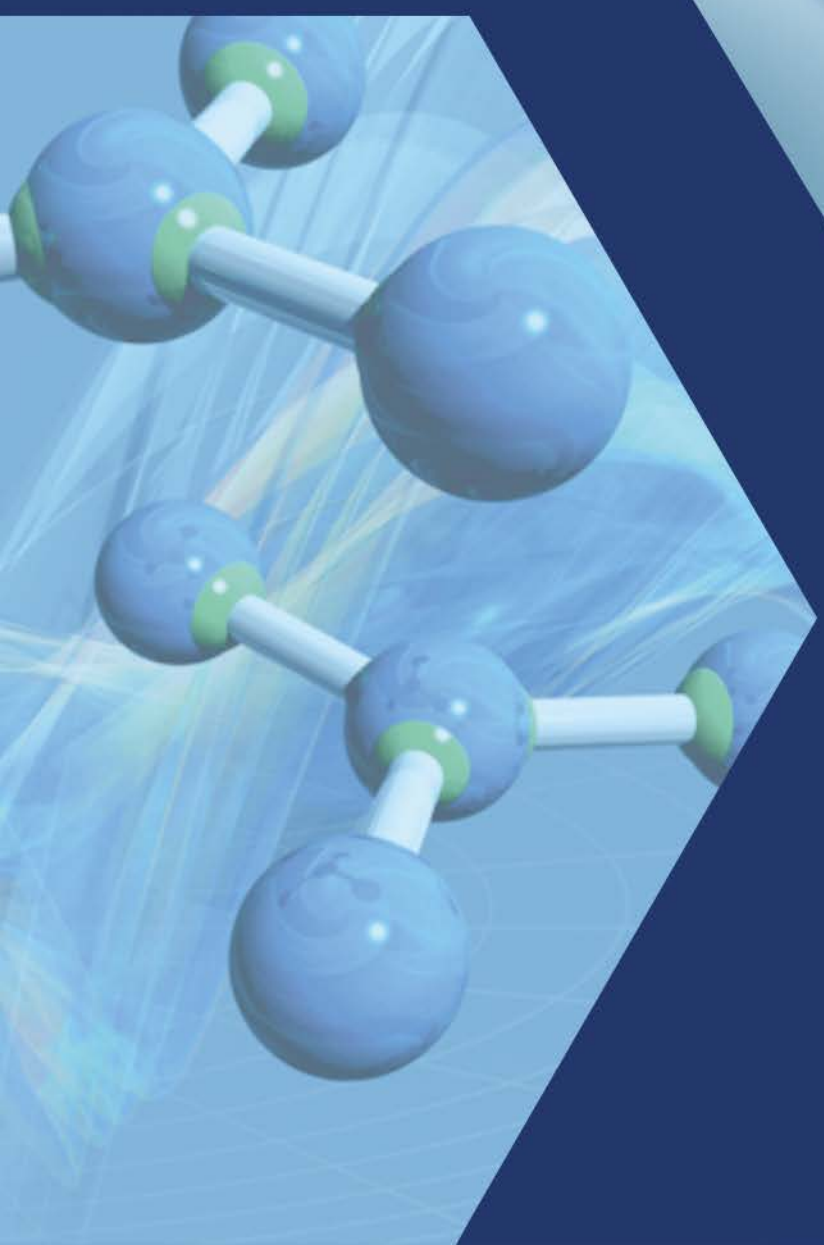
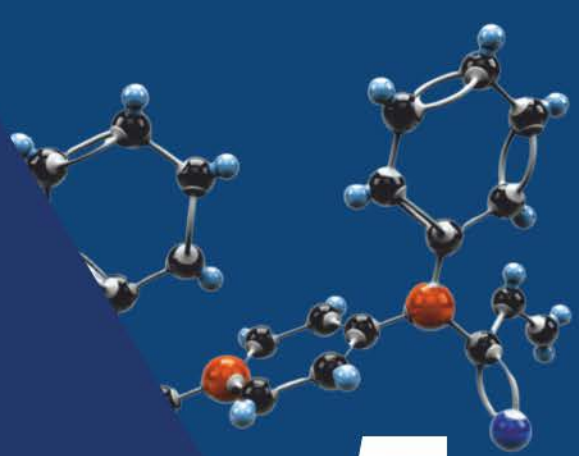
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COMPARATIVE HEPATOPROTECTIVE, ANTIOXIDANT, AND ANTI-INFLAMMATORY EFFECTS OF SAFFLOWER OIL AND COTTONSEED OIL IN PARACETAMOL-INDUCED ACUTE TOXIC HEPATITIS

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Abstract. This study evaluated the hepatoprotective, antioxidant, and anti-inflammatory effects of cold-pressed safflower oil in male Wistar rats with paracetamol-induced acute toxic hepatitis. Liver injury was induced by intragastric administration of paracetamol (1000 mg/kg) for two consecutive days, followed by oral safflower oil treatment (10 mL/kg) for 14 days. Serum biochemical markers, malondialdehyde, antioxidant enzymes, inflammatory cytokines, and liver histopathology were assessed. Paracetamol caused significant hepatic injury, characterized by increased aminotransferase and alkaline phosphatase activities, elevated malondialdehyde, reduced antioxidant enzyme activity, inflammatory alterations, and marked histopathological damage. Safflower oil significantly reduced aspartate aminotransferase and alkaline phosphatase levels, decreased malondialdehyde, restored superoxide dismutase and catalase activities, and reduced IL-1β, IL-6, and IL-4 levels ($p < 0.05$). Histological examination demonstrated reduced hepatocellular degeneration, necrosis, inflammatory infiltration, and early fibrotic changes. Thus, cold-pressed safflower oil demonstrated hepatoprotective, antioxidant, and anti-inflammatory effects in experimental paracetamol-induced acute toxic hepatitis, suggesting its potential as a natural adjunctive agent in toxic liver injury.

Keywords. *Rat; toxic hepatitis; safflower oil; hepatoprotective activity; oxidative stress; antioxidant enzymes; inflammatory cytokines; liver histology, cottonseed oil.*

Liver diseases remain one of the leading causes of mortality worldwide, claiming approximately 2 million lives annually, which accounts for about 4% of all deaths [1]. These disorders are characterised by hepatocyte injury, inflammatory infiltration, and disruption of organ architecture, leading to progressive loss of liver function [2]. According to data from the Global Burden of Disease study, in 2019, 1.26 million deaths were attributed to cirrhosis and other chronic liver diseases (a 13% increase compared with 1990), indicating a steady rise in disease burden [3].

Among these conditions, drug-induced liver injury (DILI) occupies a significant place and has become increasingly prevalent in recent decades [4]. DILI is a serious complication of pharmacotherapy and represents one of the leading causes of acute liver failure in clinical practice [5, 6]. To date, more than 1,000 substances with potential hepatotoxicity have been identified [7]. In addition to medications, hepatotropic toxins include industrial chemicals such as chloroform and phosphorus [8].

Despite the existence of general treatment approaches, including lifestyle modification and pharmacotherapy [9], no specific therapy for DILI has been developed due to the heterogeneity of its pathogenesis and individual differences in xenobiotic metabolism [10]. Because of these limitations, natural compounds with antioxidant and hepatoprotective properties have become an important focus of experimental research. Herbal preparations are considered a promising avenue for the prevention and treatment of toxic liver injuries [11].

Mitochondrial damage further enhances the generation of reactive oxygen species and reactive nitrogen species, leading to lipid peroxidation, protein oxidation, and DNA damage in hepatocytes [12]. In addition, activation of inflammatory signalling pathways, including nuclear factor-κB (NF-κB), promotes the production of pro-inflammatory cytokines and contributes to the progression of hepatic injury [13]. Therefore, compounds with antioxidant and anti-inflammatory properties have attracted considerable attention as potential therapeutic agents capable of attenuating acetaminophen-induced hepatotoxicity.

In recent years, increasing interest has been directed toward the investigation of plant-derived bioactive compounds with hepatoprotective properties. Natural polyphenols, flavonoids, and other phytochemicals have demonstrated significant antioxidant activity and the ability to activate endogenous cellular defence mechanisms [14]. In particular, many plant-derived compounds have been shown to activate the nuclear factor erythroid 2-related factor 2 (Nrf2) signalling pathway, which regulates the expression of antioxidant enzymes such as superoxide dismutase, catalase, and glutathione peroxidase [15].

Although safflower extracts have been investigated in various experimental models, data on the hepatoprotective efficacy of cold-pressed safflower oil in drug-induced toxic hepatitis remain limited. Similarly, the potential protective effects of cottonseed oil against paracetamol-induced liver injury have not been sufficiently studied.

Purpose of study. Study aim to comparatively evaluate the hepatoprotective and antioxidant effects of safflower oil and cottonseed oil in a rat model of paracetamol-induced acute toxic hepatitis.

Materials and Methods

The experimental study was conducted in collaboration with the Institute of Immunology and Human Genomics and the O.S. Sodikov Institute of Bioorganic Chemistry, Academy of Sciences of Uzbekistan. Forty healthy male Wistar rats were randomly divided into four groups (n=10): control, toxic hepatitis model (TH), TH treated with safflower oil (TH+SO), and TH treated with cottonseed oil (TH+CO). Acute toxic hepatitis was induced by intragastric administration of paracetamol at 1000 mg/kg for two consecutive days.

From day 3, safflower or cottonseed oil was administered orally at 10 mL/kg/day for 14 days. The study complied with ARRIVE 2.0 and Directive 2010/63/EU requirements.

On day 17, animals were euthanized under deep isoflurane anaesthesia, and blood and liver samples were collected. Serum ALT, AST, GGT and ALP were assessed using commercial biochemical kits. Oxidative status was evaluated by measuring MDA, catalase and SOD. Liver tissues were fixed in 10% neutral buffered formalin, processed by standard histological methods and stained with hematoxylin and eosin. Histological assessment was performed by two independent observers blinded to group allocation.

Statistical analysis was performed using Microsoft Excel and JASP 0.19.3. Data distribution was assessed using the Shapiro–Wilk test. Normally distributed variables were analysed using one-way ANOVA with Tukey's HSD test, while non-normally distributed data were analysed using the Kruskal–Wallis test followed by Dunn's test with Holm correction. Statistical significance was set at $p < 0.05$.

Results

Comparison of liver enzymes. Administration of paracetamol resulted in significant alterations in liver biochemical parameters in the model TH group compared with the healthy control group, confirming the successful induction of acute toxic hepatitis (Table 1).

Table 1

Comparison of liver enzyme levels among experimental groups

Parameter (unit)	Control (n=10)	Model TH (n=10)	Model TH + SO (n=10)	Model TH + CO (n=10)	p value
ALT (U/L)	32.2 ± 5.17[a]	47.8 ± 10.82[b]	39.4 ± 3.80[ab]	47.77 ± 10.82[b]	<0.001
AST (U/L)	35.0 [32.38–40.25] [a]	52.5 [37.6–55.1] [b]	35.0 [31.50–35.0] [a]	36.75 [32.38–42.00] [a]	0.019
ALP (U/L)	62.19 [55.28–69.10] [a]	117.47 [98.81–124.38] [c]	62.19 [55.28–75.32] [a]	96.74 [96.74–120.93] [b]	<0.001
GGT (U/L)	0.596 [0.522–0.596][a]	0.792 [0.566–0.795][a]	0.713 [0.606–0.775][a]	0.676 [0.566–0.715] [a]	0.225

Note. Data are presented as mean ± standard deviation (SD) for ALT and as median (interquartile range, IQR) for AST, ALP, and GGT. Normality was assessed using the Shapiro–Wilk test. ALT was analysed using one-way analysis of variance (ANOVA) followed by Tukey's honestly significant difference (HSD) post hoc test, whereas AST, ALP, and GGT were analysed using the Kruskal–Wallis test followed by Dunn's post hoc multiple-comparison test. Superscript letters indicate pairwise comparisons derived from the respective post hoc tests (Tukey's HSD for ALT and Dunn's test for AST, ALP, and GGT). Values sharing at least one common superscript letter are not significantly different, whereas values with no common superscript letters differ significantly ($p < 0.05$).

Animals in the model TH group exhibited significantly elevated serum ALT (47.8 ± 10.82 U/L), AST (52.5 [37.63–55.13] U/L), and ALP (117.47 [98.81–124.38] U/L) levels compared with the control group (32.2 ± 5.17 U/L, 35.0 [32.38–40.25] U/L, and 62.19 [55.28–69.10] U/L, respectively). Overall group differences were statistically significant for ALT, AST, and ALP (all $p < 0.05$), whereas GGT levels

did not differ significantly among groups (p = 0.225) (Table 1).

Treatment with safflower oil (TH+SO) attenuated paracetamol-induced liver injury. AST (35.0 [31.50–35.0] U/L) and ALP (62.19 [55.28–75.32] U/L) levels in the TH+SO group were significantly lower than those in the untreated TH group and were comparable to control values (Table 1; Figure 2). ALT activity in the TH+SO group (39.4 ± 3.80 U/L) showed an intermediate pattern and did not differ significantly from either the control or TH groups (Table 1; Figure 1).

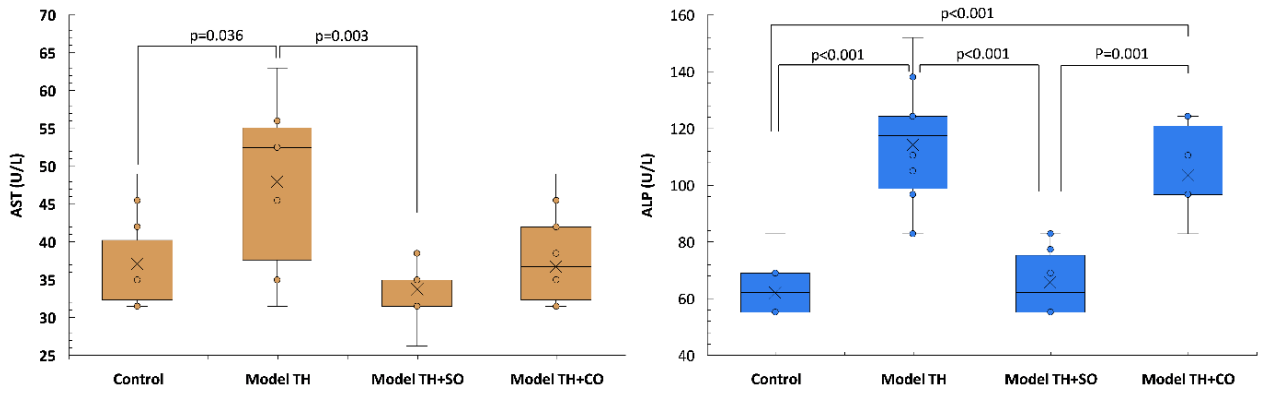


Figure 1. **Effects of safflower oil (SO) and cottonseed oil (CO) treatment on liver enzyme levels in rats with paracetamol-induced acute toxic hepatitis (TH).**

Boxplots show the median, interquartile range (IQR), and range for ALT (A) and ALP (B) levels (n = 10 per group). Group differences were evaluated using the Kruskal–Wallis test followed by Dunn's post hoc multiple-comparison test. Horizontal brackets indicate statistically significant pairwise comparisons, and the corresponding p-values are shown above the brackets. ALT, alanine aminotransferase; ALP, alkaline phosphatase.

Similarly, treatment with cottonseed oil (TH+CO) improved several liver biochemical parameters. AST activity (36.75 [32.38–42.00] U/L) was reduced to levels comparable with those of the control group (Table 1; Figure 2). ALP levels (96.74 [96.74–120.93] U/L) were significantly lower than in the untreated TH group but remained significantly higher than in both the control and TH+SO groups (Table 1; Figure 2). ALT activity in the TH+CO group (47.77 ± 10.82 U/L) remained elevated and was comparable to that observed in the untreated TH group (Table 1; Figure 3). These findings suggest that both oil treatments exerted hepatoprotective effects, with safflower oil demonstrating a greater normalisation of liver enzyme levels, particularly AST and ALP.

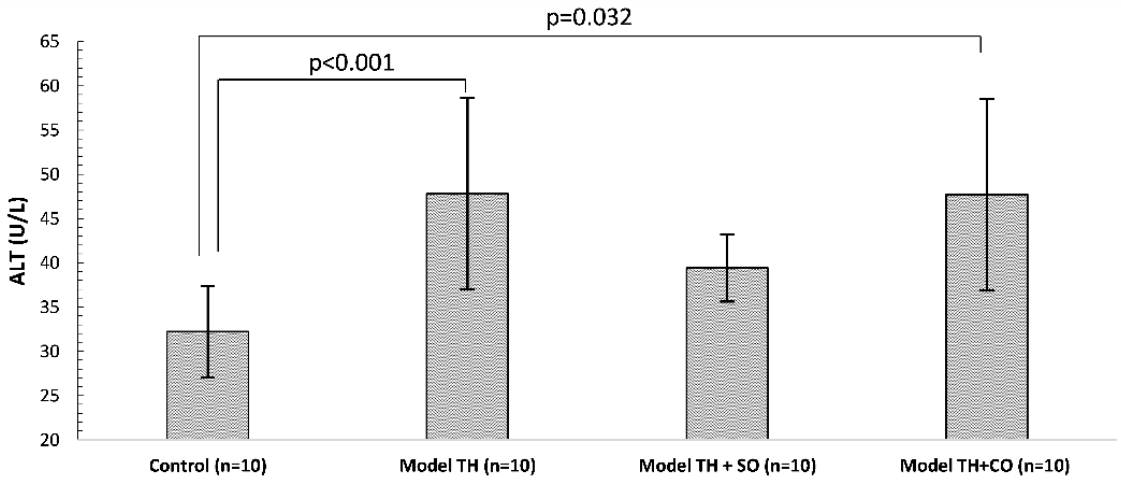


Figure 2. **Effect of safflower oil on serum ALT levels in rats with paracetamol-induced acute toxic hepatitis**.

Data are presented as mean ± SD (n = 10 per group). Group comparisons were performed using one-way ANOVA followed by Tukey's HSD post hoc test. p-values indicate statistically significant differences between the indicated groups ($p < 0.05$). ALT, alanine aminotransferase.

Paracetamol administration induced marked oxidative stress in the Model TH group, as evidenced by elevated MDA levels (3.71 [3.66–3.76] vs. 2.91 [2.85–3.02] nmol/mL in controls) and reduced catalase (22.12 [21.17–25.26] vs. 34.64 [34.21–35.59] μkat/mg) and SOD activities (1.10 [1.08–1.12] vs. 1.33 [1.29–1.35] U/mg protein) (Table 2). Treatment with safflower oil reduced MDA levels to 3.13 [3.03–3.20] nmol/mL and increased catalase and SOD activities to 30.68 [29.32–31.78] μkat/mg and 1.26 [1.24–1.27] U/mg protein, respectively. Cottonseed oil also improved oxidative stress parameters, reducing MDA levels to 3.225 [3.167–3.333] nmol/mL and increasing catalase and SOD activities to 29.905 [28.470–31.020] μkat/mg and 1.210 [1.200–1.240] U/mg protein. Overall, both oils exhibited antioxidant effects, with safflower oil showing a greater normalization of MDA levels, while catalase and SOD activities were similarly improved by both treatments (Table 2).

Table 2.

Oxidative stress marker (MDA) and antioxidant enzyme activities (SOD and Catalase) in experimental groups

Parameter (unit)	Control (n = 10)	Model TH (n = 10)	Model TH + SO (n = 10)	**Model TH + CO (n=10)**	p value (Kruskal–Wallis)
MDA (nmol/mL)	2.91 [2.85–3.02][a]	3.71 [3.66–3.76] [b]	3.13 [3.03–3.20] [a]	3.22 [3.167–3.33] [c]	<0.001

Catalase (μkat/mg)	34.64 [34.21–35.59][a]	22.12 [21.17–25.26][b]	30.6 [29.3–31.7][c]	29.9 [28.4–31.02][c]	<0.001
SOD (U/mg protein)	1.33 [1.29–1.35][a]	1.10 [1.08–1.12][b]	1.26 [1.24–1.27] [c]	1.210 [1.2–1.24][c]	<0.001

Note. Data are presented as median with interquartile range (IQR). Group differences were assessed using the Kruskal–Wallis test, followed by Dunn's post-hoc test. Values sharing the same superscript letter within a row are not significantly different, whereas values with different superscript letters are significantly different ($p < 0.05$).

Comparison of inflammatory marker levels. Paracetamol administration induced a marked inflammatory response, as reflected by significantly elevated serum levels of IL-1β, IL-6, IL-4, and TNF-α in the Model TH group compared with the control group (Table 3).

Table 3.

Comparison of serum inflammatory cytokine levels in experimental groups

Parameter (unit)	Control (n=10)	Model TH (n=10)	Model TH + SO (n=10)	Model TH + CO (n=10)	p-value (Kruskal–Wallis)
IL-1β (pg/mL)	7.18 [6.64–7.73] [a]	15.75 [11.46–27.21] [b]	11.88 [10.54-12.29] [b]	12.910 [10.90–14.02] [b]	<0.001
IL-6 (pg/mL)	2.53 [2.25–2.57] [a]	4.33 [3.97–4.49] [b]	3.52 [3.48–3.62] [b]	3.545 [3.275–3.945] [b]	<0.001
IL-4 (pg/mL)	1.19 [1.02–1.24] [a]	3.65 [3.18–5.10] [b]	2.37 [2.20–2.87] [ab]	2.895 [2.77–3.14] [b]	<0.001
TNF-α (pg/mL)	9.67 [8.77–10.28] [a]	34.90 [26.78–45.60][b]	23.25 [19.60–29.00][b]	29.8 [26.87–32.53][b]	<0.001

Note. Data are expressed as median (interquartile range, IQR). Differences among groups were evaluated using the Kruskal–Wallis test followed by Dunn's post hoc multiple-comparison test with Holm adjustment. Superscript letters indicate pairwise comparisons: groups sharing at least one common letter are not significantly different, whereas groups with no common letters differ significantly ($p < 0.05$).

Specifically, IL-1β increased from 7.18 [6.64–7.73] pg/mL in controls to 15.75 [11.46–27.21] pg/mL in the Model TH group, while IL-6 increased from 2.53 [2.25–2.57] to 4.33 [3.97–4.49] pg/mL. Similarly, IL-4 and TNF-α concentrations were significantly higher in the Model TH group (3.65 [3.18–5.10] and 34.90 [26.78–45.60] pg/mL, respectively) than in controls (1.19 [1.02–1.24] and 9.67 [8.77–10.28] pg/mL, respectively; all $p < 0.001$).

Treatment with safflower oil (TH+SO) partially attenuated the inflammatory response. IL-1β and IL-6 levels decreased to 11.88 [10.54–12.29] pg/mL and 3.52 [3.48–3.62] pg/mL, respectively, although they remained significantly higher than control values. IL-4 levels in the TH+SO

group (2.37 [2.20–2.87] pg/mL) showed partial normalization and did not differ significantly from either the control or Model TH groups. TNF-α concentrations remained elevated in the TH+SO group (23.25 [19.60–29.00] pg/mL) and did not differ significantly from the untreated Model TH group.

Similar findings were observed in the cottonseed oil-treated group (TH+-CO). Serum IL-1β, IL-6, IL-4, and TNF-α levels were 12.910 [10.90–14.02], 3.545 [3.275–3.945], 2.895 [2.777–3.147], and 29.800 [26.875–32.535] pg/mL, respectively. These values were intermediate between those of the control and untreated TH groups and did not differ significantly from the TH+SO group. Overall, both safflower oil and cottonseed oil partially mitigated paracetamol-induced inflammatory activation, although cytokine levels generally remained above those observed in healthy controls (Table 3).

Morphological assessment. Histopathological examination of liver tissue confirmed the biochemical findings (Figure 4). In the healthy control group, the normal hepatic architecture was preserved, with well-organized hepatic cords, intact hepatocytes, and no evidence of steatosis, inflammation, or fibrosis (Figure 4A, 4E, 4I).

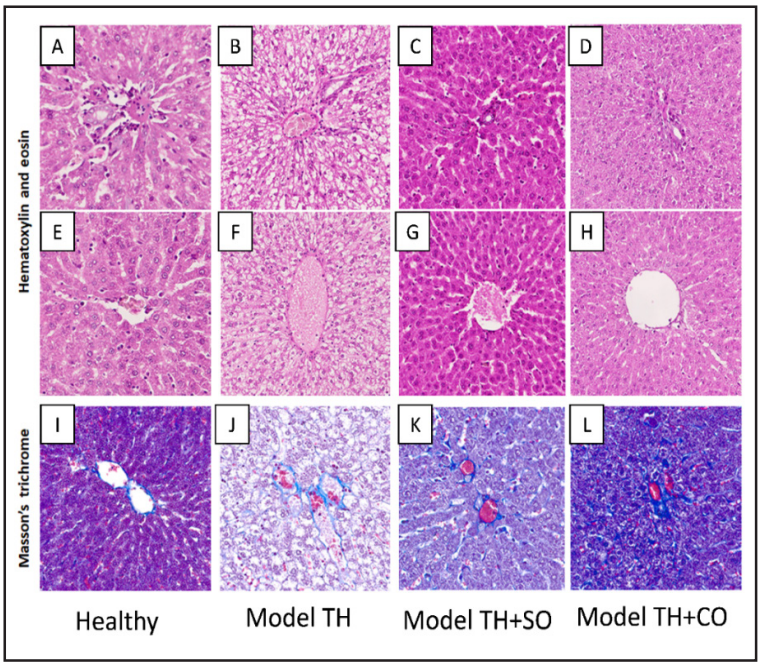


Figure 3. **Representative histopathological changes in the liver of rats from the control, model, and treatment groups. Haematoxylin and eosin staining, ×200 (A–H); Masson's trichrome staining, ×200 (I–L).**

In the untreated model group (TH), marked pathological alterations were observed, including pronounced fatty degeneration of hepatocytes, disruption of the hepatic architecture, hepatocellular necrosis, and moderate inflammatory cell infiltration (Figure 4B, 4F, 4J). Masson's trichrome staining demonstrated the presence of thin fibrotic strands surrounding central veins and extending into the intercellular matrix, indicating the development of early fibrotic changes (Figure 4J).

Treatment with safflower oil (TH+SO)

substantially attenuated liver injury. The hepatic architecture was largely restored, hepatocytes exhibited near-normal morphology, and only occasional areas of fatty degeneration were observed. Inflammatory infiltration was minimal, and hepatocellular integrity was preserved (Figure 4C, 4G). Masson's trichrome staining revealed only sparse collagen deposition, represented by isolated thin fibrous strands between hepatocytes, indicating a marked reduction in fibrosis compared with the untreated model group (Figure 4K).

Treatment with cottonseed oil (TH+-CO) also improved liver morphology compared with the untreated model group. The normal cord-like architecture of the liver was largely preserved, and hepatocytes displayed regular polygonal morphology with oval nuclei and mild hyperchromasia. The cytoplasm was predominantly homogeneous, with only slight vacuolar changes and minimal fatty degeneration. Hepatic sinusoids and portal structures remained intact, with no significant inflammatory infiltration or necrosis (Figure 4D, 4H). Masson's trichrome staining showed only mild collagen deposition, substantially lower than in the untreated model group but slightly more pronounced than in the safflower oil-treated group (Figure 4L).

Overall, both safflower oil and cottonseed oil exerted hepatoprotective effects; however, the safflower oil-treated group demonstrated the most complete restoration of hepatic architecture and the lowest degree of fibrosis.

Semi-quantitative assessment of hepatic steatosis and related histopathological changes was performed using the histological scoring system developed by the Nonalcoholic Steatohepatitis Clinical Research Network (NASH CRN, USA) [17] and subsequently modified by the American Association for the Study of Liver Diseases (AASLD) [18]. Although this scoring system was originally developed for the evaluation of liver histology in humans, Liang et al. (2014) demonstrated its applicability for histopathological assessment in rat models of liver disease [19]. The results of the semi-quantitative evaluation of histological changes in rat liver tissue are presented in Table 4.

Table 4.

Semi-quantitative histopathological assessment of hepatic steatosis and liver injury

Group	**Steatosis**			**Fibrosis**	**Inflammation**				**Ballooning**	**Total Score**	**Diagnosis**
	Grade	Distribution	Microvesicular Steatosis		Lobular Inflammation	Microgranulomas	Large Lipogranulomas	Portal Inflammation			
Control	0	0	0	0	0	0	0	0	0	0	Normal
Model	3	3	1	1	2	0	0	1	2	13	NASH
Safflower Oil Treatment	1	0	1	1	0	0	0	0	0	3	NAFLD
Cottonseed Oil Treatment	1	0	1	1	0	0	0	1		4	NAFLD

Semi-quantitative histopathological assessment demonstrated marked liver injury in the untreated model group, which achieved the highest total score (13) and was classified as non-alcoholic steatohepatitis (NASH). This group exhibited severe steatosis, extensive distribution of lipid accumulation, fibrosis, lobular and portal inflammation, and pronounced hepatocellular ballooning. In contrast, both safflower oil and cottonseed oil treatments substantially reduced the severity of histopathological alterations, resulting in total scores of 3 and 4, respectively, consistent with non-alcoholic fatty liver disease (NAFLD). The safflower oil-treated group showed the greatest improvement, with minimal steatosis, absence of inflammatory changes and ballooning degeneration, and the lowest overall histological score. These findings indicate that both oils exerted hepatoprotective effects, with safflower oil demonstrating a slightly stronger protective effect against liver injury than cottonseed oil.

Conclusion

Cold-pressed safflower oil demonstrated significant hepatoprotective activity in rats with paracetamol-induced acute toxic hepatitis. Its administration attenuated biochemical signs of liver injury, particularly by reducing AST and alkaline phosphatase levels. Safflower oil also exerted a pronounced antioxidant effect, characterized by a decrease in malondialdehyde levels and restoration of superoxide dismutase and catalase activities. The treatment partially modulated the inflammatory response, significantly reducing IL-1β, IL-6, and IL-4 concentrations, although TNF-α remained elevated. Histopathological findings further confirmed a reduction in hepatocellular degeneration, necrosis, inflammatory infiltration, and early fibrotic changes. Overall, these findings indicate that safflower oil exerts a combined hepatoprotective, antioxidant, and anti-inflammatory effect and may have potential as a natural adjunctive approach for the prevention and management of toxic liver injury.

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СРАВНИТЕЛЬНОЕ ГЕПАТОПРОТЕКТОРНОЕ, АНТИОКСИДАНТНОЕ И ПРОТИВОВОСПАЛИТЕЛЬНОЕ ДЕЙСТВИЕ САФЛОРОВОГО И ХЛОПКОВОГО МАСЕЛ ПРИ ОСТРОМ ТОКСИЧЕСКОМ ГЕПАТИТЕ, ВЫЗВАННОМ ПАРАЦЕТАМОЛОМ

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Аннотация. Целью настоящего исследования явилась оценка гепатопротекторного, антиоксидантного и противовоспалительного действия холодного отжима сафлорового масла у самцов крыс линии Wistar с острым токсическим гепатитом, вызванным парацетамолом. Поражение печени моделировали путем внутрижелудочного введения парацетамола в дозе 1000 мг/кг в течение двух последовательных дней, после чего сафлоровое масло вводили перорально в дозе 10 мл/кг в течение 14 дней. Оценивали биохимические показатели сыворотки крови, уровень малонового диальдегида, активность антиоксидантных ферментов, содержание провоспалительных и противовоспалительных цитокинов, а также гистопатологические изменения ткани печени. Введение парацетамола сопровождалось выраженным повреждением печени, характеризовавшимся повышением активности аминотрансфераз и щелочной фосфатазы, увеличением уровня малонового диальдегида, снижением активности антиоксидантных ферментов, воспалительными

изменениями и выраженными морфологическими повреждениями. Применение сафлорового масла способствовало достоверному снижению уровней аспартатаминотрансферазы и щелочной фосфатазы, уменьшению концентрации малонового диальдегида, восстановлению активности супероксиддисмутазы и каталазы, а также снижению уровней IL-1β, IL-6 и IL-4 ($p<0,05$). Гистологическое исследование выявило уменьшение выраженности дегенеративных изменений гепатоцитов, некроза, воспалительной инфильтрации и начальных фибротических изменений. Таким образом, холодного отжима сафлоровое масло оказывает выраженное гепатопротекторное, антиоксидантное и противовоспалительное действие при экспериментальном остром токсическом гепатите, вызванном парацетамолом, что позволяет рассматривать его как перспективное натуральное средство в качестве дополнения к профилактике и коррекции токсического поражения печени.

Ключевые слова: крысы; токсический гепатит; сафлоровое масло; гепатопротекторное действие; окислительный стресс; антиоксидантные ферменты; воспалительные цитокины; гистология печени; хлопковое масло.

ПАРАЦЕТАМОЛ ЧАҚИРГАН ЎТКИР ТОКСИК ГЕПАТИТДА САФЛОР ВА ПАХТА МОЙЛАРИНИНГ ГЕПАТОПРОТЕКТОР, АНТИОКСИДАНТ ВА ЯЛЛИҒЛАНИШГА ҚАРШИ ТАЪСИРИНИ ҚИЁСИЙ БАҲОЛАШ

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Аннотация. Мазкур тадқиқотнинг мақсади парацетамол чақирган ўткир токсик гепатит моделида эркак Wistar каламушларида совуқ усулда олинган сафлор мойининг гепатопротектор, антиоксидант ва яллиғланишга қарши таъсирини баҳолашдан иборат бўлди. Жигар шикастланиши парацетамолни 1000 мг/кг дозада икки кун давомида меъда ичига юбориш орқали моделлаштирилди, шундан сўнг сафлор мойи 10 мл/кг дозада 14 кун давомида оғиз орқали берилди. Қон зардобининг биокимёвий кўрсаткичлари, малондиальдегид миқдори, антиоксидант ферментлар фаоллиги, яллиғланиш цитокинлари даражаси ҳамда жигар тўқимасининг гистопатологик ўзгаришлари баҳоланди. Парацетамол юборилиши аминотрансферазалар ва ишқорий фосфатаза фаоллигининг ошиши, малондиальдегид миқдорининг кўпайиши, антиоксидант ферментлар фаоллигининг пасайиши, яллиғланиш ўзгаришлари ва жигар тўқимасида яққол морфологик шикастланишлар билан намоён бўлган сезиларли жигар зарарланишига олиб келди. Сафлор мойини қўллаш аспартатаминотрансфераза ва ишқорий фосфатаза даражаларини ишончли камайтирди, малондиальдегид миқдорини пасайтирди, супероксиддисмутаза ва каталаза фаоллигини тиклади ҳамда IL-1β, IL-6 ва IL-4 даражаларини сезиларли равишда камайтирди ($p < 0,05$). Гистологик текширув сафлор мойи билан даволанган ҳайвонларда гепатоцитлар дегенерацияси, некроз, яллиғланиш инфильтрацияси ва дастлабки фибротик ўзгаришлар ифодаланишининг камайганини кўрсатди. Шундай қилиб, совуқ усулда олинган сафлор мойи парацетамол чақирган экспериментал ўткир токсик гепатитда яққол гепатопротектор, антиоксидант ва яллиғланишга қарши таъсир кўрсатади ҳамда жигарнинг токсик шикастланишини профилактика қилиш ва комплекс коррекциялашда истиқболли табиий қўшимча восита сифатида қаралиши мумкин.

Калит сўзлар: каламушлар; токсик гепатит; сафлор мойи; гепатопротектор таъсир; оксидловчи стресс; антиоксидант ферментлар; яллиғланиш цитокинлари; жигар гистологияси; пахта мойи.