Comparison of the Hepatoprotective Effectiveness of Ethanol Extract of Moringa oleifera L. and Elephantopus scaber Linn. Leaves on ALT (SGPT) Levels in Mice

Dian Arsanti Palupi*, Gunawan Firmansyah, Fatimah Az Zahra Putri Sikos, Hasty Martha Wijaya

Institut Teknologi Kesehatan Cendekia Utama Kudus, Indonesia

*Corresponding Author: dianarsanti68@gmail.com

Abstract. Hepatoprotective agents are substances that help protect the liver from damage caused by hepatotoxic compounds. Liver injury can be identified by elevated serum glutamic pyruvic transaminase (SGPT) levels, which indicate hepatocellular damage. Moringa oleifera L. (moringa) leaves and Elephantopus scaber L. (elephant's foot) leaves contain bioactive compounds, including flavonoids, alkaloids, saponins, and tannins, which are believed to exert hepatoprotective effects through their antioxidant properties. This study aimed to compare the hepatoprotective activities of ethanolic extracts of Moringa oleifera leaves and Elephantopus scaber leaves against SGPT elevation in mice induced with a toxic dose of paracetamol. This experimental study employed a posttest-only control group design using 20 male Swiss Webster mice randomly assigned to four groups: negative control (0.5% CMC), positive control (silymarin 200 mg/kg BW), Moringa oleifera leaf ethanolic extract (250 mg/kg BW), and Elephantopus scaber leaf ethanolic extract (450 mg/kg BW). One hour after treatment administration, mice received oral paracetamol at 2 g/kg BW for 14 consecutive days. Serum SGPT levels were measured spectrophotometrically. The results demonstrated that both extracts significantly reduced SGPT levels compared with the negative control. The hepatoprotective activity of the Moringa oleifera leaf extract was significantly greater than that of the Elephantopus scaber leaf extract ($p \leq 0.05$) and was not significantly different from that of silymarin ($p > 0.05$). In conclusion, both extracts exhibited hepatoprotective activity; however, the ethanolic extract of Moringa oleifera leaves showed superior hepatoprotective efficacy and was comparable to silymarin in protecting against paracetamol-induced liver injury.

Keywords: Hepatoprotective activity; Moringa oleifera; Elephantopus scaber; Paracetamol-induced hepatotoxicity; SGPT.

INTRODUCTION

The liver is a vital organ that plays a key role in metabolism, detoxification, protein synthesis, and the storage of various essential substances within the body. As the primary organ for drug metabolism, the liver is highly susceptible to damage from exposure to hepatotoxic compounds (Hall, 2025) Liver damage can result from infections, alcohol consumption, chemical exposure, or the use of medications at high doses or over long periods. (Cortés & García, 2022). One of the most frequently reported causes of Drug-Induced Liver Injury (DILI) is the use of paracetamol in excess of therapeutic doses. Consequently, the search for effective hepatoprotective agents has become a research focus in the development of therapies based on natural products (Fontana *et al.*, 2023). Paracetamol is an analgesic and antipyretic drug that is relatively safe when used at therapeutic doses. However, the use of paracetamol at toxic doses can cause acute liver damage. Paracetamol hepatotoxicity occurs because a small fraction of the drug is metabolized by cytochrome P450 enzymes specifically CYP2E1 into the reactive metabolite N-acetyl-p-benzoquinone imine (NAPQI).

Under normal conditions, NAPQI is neutralized by glutathione (GSH). However, the administration of toxic doses of paracetamol such as 2 g/kg body weight in mice depletes glutathione reserves, causing NAPQI to bind to hepatocyte proteins and trigger oxidative stress, lipid peroxidation, mitochondrial dysfunction, and liver cell necrosis, ultimately resulting in hepatic damage (Jaeschke & Ramachandran, 2024). Paracetamol-induced liver damage can be assessed by monitoring elevated levels of the enzymes Serum Glutamate Pyruvate Transaminase (SGPT/ALT) and Serum Glutamate Oxaloacetate Transaminase (SGOT/AST) in the serum. An increase in these enzymes reflects damage to hepatocyte membranes, resulting in the release of intracellular enzymes into the bloodstream. (Anindyaguna *et al*., 2022). Of the two parameters, SGPT is considered a more specific marker of hepatocellular damage because it is predominantly located within the cytoplasm of liver cells. Consequently, measuring SGPT levels is frequently used as a primary indicator in hepatoprotective research.Paracetamol-induced liver damage can be assessed by monitoring elevated levels of the enzymes Serum Glutamate Pyruvate

Transaminase (SGPT/ALT) and Serum Glutamate Oxaloacetate Transaminase (SGOT/AST) in the serum. An increase in these enzymes reflects damage to hepatocyte membranes, resulting in the release of intracellular enzymes into the bloodstream. Of the two parameters, SGPT is considered a more specific marker of hepatocellular damage because it is predominantly located within the cytoplasm of liver cells. Consequently, measuring SGPT levels is frequently used as a primary indicator in hepatoprotective (Nugrahini *et al*, 2022)

Moringa leaves (Moringa oleifera L.) are known to be rich in secondary metabolites such as flavonoids, phenolics, vitamin C, β-carotene, quercetin, kaempferol, and chlorogenic acid that possess potent antioxidant activity. Various studies have reported that Moringa leaf extract can lower SGPT and SGOT levels, enhance the activity of antioxidant enzymes (such as superoxide dismutase (SOD), catalase (CAT), and glutathione peroxidase (GPx), and reduce hepatocyte necrosis in various models of hepatotoxicity. These activities indicate that Moringa leaves have potential as hepatoprotective agents through antioxidant and anti-inflammatory mechanisms. (Suaskara *et al*, 2024)

Tapak liman (Elephantopus scaber L.) has long been utilized as a traditional medicinal plant. It contains flavonoids, sesquiterpene lactones (such as deoxyelephantopin), phenolic compounds, alkaloids, and tannins, all of which act as antioxidants and anti-inflammatory agents. Several studies have demonstrated that tapak liman extract can reduce SGPT and SGOT levels in test animals suffering from liver damage caused by oxidative stress, as well as improve liver histopathology. This hepatoprotective activity is believed to be linked to the plant's ability to inhibit free radical formation, suppress inflammatory processes, and boost the endogenous antioxidant defense system (Prasuma *et al*., 2024).

Although various studies have demonstrated the hepatoprotective activity of both Moringa oleifera (kelor) and Elephantopus scaber (tapak liman) leaves, most research has evaluated these plants separately using different models of hepatotoxicity induction. To date, studies directly comparing the hepatoprotective efficacy of Moringa oleifera and Elephantopus scaber leaf extracts in a model of hepatotoxicity induced by a toxic dose of paracetamol (2 g/kg body weight) remain very limited. Comparing these two plants is crucial to determine which exhibits superior hepatoprotective activity, thereby providing a basis for developing phytopharmaceuticals as an adjunct therapy to prevent drug-induced liver damage (Meshack, 2022)

Based on the foregoing, this study was conducted to compare the hepatoprotective effects of Moringa oleifera L. (moringa) leaf extract and Elephantopus scaber L. (tapak liman) herb extract on SGPT levels in mice induced with a toxic dose of paracetamol (2 g/kg body weight). The study results are expected to provide scientific information regarding the relative hepatoprotective effectiveness of both plants and serve as a basis for developing safe and effective natural agents with the potential to become phytopharmaceutical candidates for managing drug-induced liver damage.

MATERIALS AND METHODS

Materials

Moringa leaves (Moringa oleifera L.) and tapak liman herb (Elephantopus scaber L.), 70% ethanol, distilled water, 0.5% sodium carboxymethyl cellulose (Na-CMC), paracetamol, SGPT (ALT) reagent kit, EDTA, phytochemical reagents, and 20 healthy male Swiss Webster mice (Mus musculus) aged 2–3 months and weighing 20–30 grams.

Analytical balance, maceration vessel, blender, stainless steel knife, 40-mesh sieve, beaker, graduated cylinder, volumetric flask, glass funnel, Whatman No. 1 filter paper, vacuum rotary evaporator, water bath, evaporating dish, drying oven, oral gavage needle for mice, animal housing cage, syringe, microtube, EDTA tube, centrifuge, micropipette and tips, test tube rack, vortex mixer, and UV-Vis spectrophotometer.

Methods

All procedures involving the use of animals in this study were approved by the Animal Research Ethics Committee of the Faculty of Mathematics and Natural Sciences, Muhammadiyah University Purwokerto (ethics approval number KEPK/UMP/75/IV/2025) and were conducted in accordance with guidelines governing the protection and welfare of laboratory animals. The experimental animals selected were 20 male white mice (Mus musculus) of the Swiss Webster strain.

a. Preparation of Extracts
Fresh leaves of Moringa oleifera L. and Elephantopus scaber L. were washed thoroughly under running water and dried in a drying cabinet at 40–50°C until completely dehydrated. The dried leaves were then ground into powder using a blender and sieved through a 40-mesh sieve to obtain a homogeneous simplicia powder.The powdered simplicia of each plant was extracted separately by the maceration method using 70% ethanol at a simplicia- to-solvent ratio of 1:10 (w/v). Maceration was carried out at room temperature for 3 × 24 h with stirring every 24 h. The marc was remacerated twice using fresh solvent to maximize extraction efficiency. All filtrates were combined and concentrated using a rotary evaporator at 40–50°C until a viscous extract was obtained. The extracts were stored in airtight containers until further analysis.

b. Phytochemical Screening
Phytochemical screening was performed on the 70% ethanol extracts of Moringa oleifera leaves and Elephantopus scaber leaves to identify the presence of flavonoids using the Wilstätter and Bate-Smith tests. For the Wilstätter (Shinoda) test, approximately 1 mL of the extract solution was mixed with a small amount of magnesium powder followed by the addition of concentrated hydrochloric acid (HCl). The appearance of a red, pink, orange, or reddish-purple color indicated the presence of flavonoids. For the Bate-Smith test, approximately 1 mL of the extract solution was treated with concentrated hydrochloric acid and heated in a water bath for 15 minutes. The development of a red to dark red color indicated the presence of flavonoids, particularly flavan-3-ols or proanthocyanidins.

c. Hepatoprotective Activity Assay
Twenty male Swiss Webster mice (Mus musculus), aged 8–10 weeks and weighing 20–30 g, were used in this study. The animals were acclimatized for seven days under standard laboratory conditions with free access to standard chow and drinking water (ad libitum). The mice were randomly divided into four groups (n = 5 per group) as follows: Group I (Negative Control): received 0.5% sodium carboxymethyl cellulose (Na-CMC) suspension orally, followed one hour later by paracetamol at a dose of 2 g/kg body weight.. Group II (Positive Control): received silymarin at a dose of 100 mg/kg body weight orally, followed one hour later by paracetamol at a dose of 2 g/kg body weight. Group III: received 70% ethanol extract of Moringa oleifera leaves at a dose of 250 mg/kg body weight orally, followed one hour later by paracetamol at a dose of 2 g/kg body weight. Group IV: received 70% ethanol extract of Elephantopus scaber leaves at a dose of 450 mg/kg body weight orally, followed one hour later by paracetamol at a dose of 2 g/kg body weight. All treatments were administered orally once daily for 14 consecutive days. Twenty-four hours after the final treatment, blood samples were collected for the determination of serum alanine aminotransferase (SGPT/ALT) levels.

d. Determination of Serum SGPT Levels
Blood samples were collected from the retro-orbital sinus using sterile hematocrit capillary tubes. The collected blood was transferred into plain tubes without anticoagulant and allowed to clot at room temperature for 30 minutes. The samples were then centrifuged at 3,000 rpm for 10 minutes to obtain serum. A total of 100 µL of serum was mixed with 1,000 µL of SGPT reagent according to the manufacturer's instructions. The mixture was homogenized and incubated as specified in the diagnostic kit protocol. Absorbance was measured using a UV-Visible spectrophotometer at a wavelength of 340 nm. Serum glutamate pyruvate transaminase (SGPT/ALT) levels were expressed in units per liter (U/L).

RESULTS AND DISCUSSION

a. Results Of Phytochemical Screening
Phytochemical test results indicate that dry extracts of Moringa oleifera L. (moringa) and Elephantopus scaber Linn. (tapak liman) leaves tested positive for flavonoids using the Wilstätter (Mg + concentrated HCl) and Bate-Smith (concentrated HCl) reagents. A positive reaction was evidenced by the development of a reddish-orange color with the Wilstätter reagent and a reddish-brown color with the Bate-Smith reagent, indicating the presence of flavonoids. The results of the phytochemical screening are presented in Table 1.

Table 1. Phytochemical Screening

Secondary metabolite	Reagent	Interpretation	Moringa oleifera L	Elephantopus scaber Linn
Flavonoid	Willstater	Orange color	+	+
	Bate smith	Reddish brown color	+	+

Flavonoids are polyphenolic compounds widely recognized for their biological activities as antioxidants, anti-inflammatories, and hepatoprotective agents. These findings align with research by (Gulo & Saragih, 2021), which reported that Elephantopus scaber (tapak liman) leaves contain flavonoids and exhibit hepatoprotective activity through antioxidant and anti-inflammatory mechanisms. Furthermore, (Nawir, *et al*, 2021) demonstrated that the ethanolic extract of Moringa oleifera (kelor) leaves contains active flavonoids capable of reducing biomarkers of liver damage in animal models induced with carbon tetrachloride (CCl_4). Another study by (Ainun *et al.*, 2022) noted that flavonoids along with phenolics, tannins, vitamin C, alkaloids, and saponins function as antioxidants and repair tissue cells damaged by oxidative stress.

b. Results Of The Hepatoprotective Activity Assessment

Tabel 2. Mean Serum ALT (SGPT) Levels After Extract Administration and Paracetamol Induction

Groups	Serum alanine aminotransferase (ALT) levels/ SGPT	
	After Extract Treatment	After paracetamol induction
K1	26,44	42,52
K2	19,65	20,87
K3	19,38	21,94
K4	26,73	31,14

K1: Negative control
K2: Positive control (Silymarin) K3: Moringa oleifera leaf extract
K4: Elephantopus scaber leaf extract

The results of this study demonstrated that the ethanolic extracts of Moringa oleifera L. and Elephantopus scaber L. leaves exhibited hepatoprotective activity in mice induced with toxic doses of paracetamol. This was evidenced by lower Serum Glutamate Pyruvate Transaminase (SGPT) levels in the treatment groups compared with the negative control group, indicating reduced hepatocellular damage following paracetamol-induced liver injury.The elevation of SGPT levels reflects hepatocellular injury because this enzyme is predominantly localized in the cytoplasm of hepatocytes and is released into the bloodstream when the integrity of the cell membrane is compromised. Such liver injury is primarily caused by the formation of the toxic metabolite N-acetyl-p-benzoquinone imine (NAPQI), which depletes intracellular glutathione, promotes oxidative stress, induces lipid peroxidation, and ultimately leads to hepatocyte necrosis (Li *et al.*, 2025)

The hepatoprotective activity of the Moringa oleifera leaf extract is likely associated with its phytochemical constituents, particularly flavonoids, quercetin, kaempferol, and other phenolic compounds. These bioactive compounds exert antioxidant effects by scavenging free radicals, enhancing endogenous antioxidant defense systems, and suppressing oxidative stress. In contrast, the hepatoprotective effect of the Elephantopus scaber leaf extract is presumed to be attributable to the presence of flavonoids, deoxyelephantopin,, and sesquiterpene lactones, which possess antioxidant and anti-inflammatory properties capable of attenuating hepatocellular damage (Nguyen & Phan, 2022)

% Increased SGPT= SGPT after extract treatnent - SGPT after paracetamol induced x 100% SGPT after extract treatment

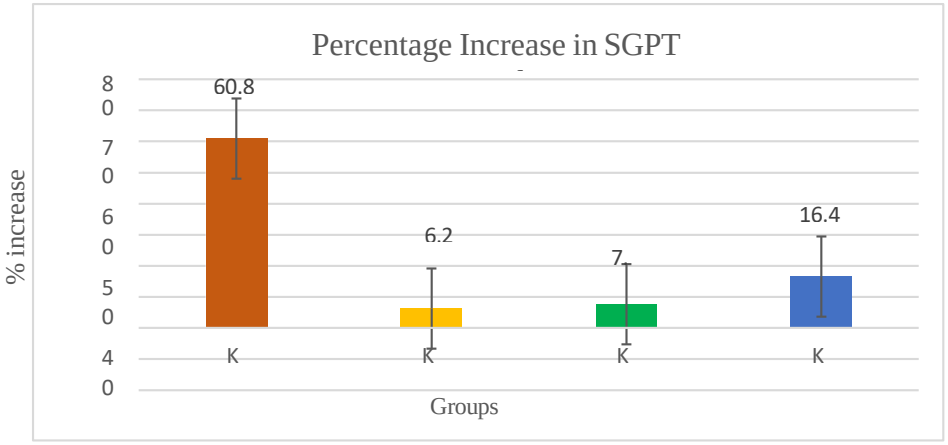

Figure 1. Percentage Increase In SGPT Levels

Based on Figure 1, the mean percentage increase in Serum Glutamic Pyruvic Transaminase (SGPT) levels following paracetamol induction differed among the experimental groups. The negative control group (K1), which received only 0.5% CMC-Na, exhibited the highest percentage increase in SGPT levels, reaching 60.81%. This finding indicates substantial hepatocellular damage caused by paracetamol-induced hepatotoxicity. CMC-Na functions solely as a suspending agent and possesses no pharmacological or hepatoprotective activity; therefore, it is unable to prevent the formation of toxic paracetamol metabolites or attenuate liver cell damage.

In contrast, the positive control group (K2), which received silymarin, demonstrated the lowest percentage increase in SGPT levels at 6.21%, indicating a strong hepatoprotective effect. Silymarin is a potent antioxidant that scavenges free radicals, inhibits lipid peroxidation, stabilizes hepatocyte membranes, and promotes liver cell regeneration, thereby preserving hepatic tissue integrity following exposure to hepatotoxic agents (Aghemo *et al.*, 2022)

The treatment group receiving the 70% ethanolic extract of Moringa (Moringa oleifera L.) leaves (K3) showed a 7.60% increase in SGPT levels, which was comparable to that observed in the silymarin-treated group. This result suggests that the ethanolic extract of Moringa oleifera leaves possesses significant hepatoprotective activity (Younis *et al*., 2022). The protective effect is likely attributable to its rich content of bioactive compounds, including flavonoids, polyphenols, vitamin C, and other phenolic constituents. These compounds function as natural antioxidants by scavenging reactive oxygen species, enhancing endogenous antioxidant enzyme activity, and suppressing oxidative stress, thereby protecting hepatocytes from damage induced by toxic paracetamol metabolites (Nurhayati *et al*., 2024)

Meanwhile, the group treated with the 70% ethanolic extract of Elephantopus scaber L. leaves (K4) exhibited a 16.49% increase in SGPT levels. Although this value was higher than those observed in the silymarin and Moringa oleifera groups, it remained substantially lower than that of the negative control group. These findings indicate that Elephantopus scaber leaf extract also possesses hepatoprotective activity, albeit with lower efficacy than Moringa oleifera leaf extract. This hepatoprotective effect is presumed to be associated with the presence of bioactive constituents such as elephantopin and sesquiterpene lactones, which exhibit antioxidant and anti-inflammatory properties capable of mitigating oxidative damage to hepatocytes (Lin *et al.*, 2021).

The marked elevation of SGPT levels in the negative control group can be explained by the metabolism of toxic doses of paracetamol in the liver through the cytochrome P450 enzyme system, particularly CYP2E1, which converts paracetamol into the highly reactive metabolite N-acetyl-p-benzoquinone imine (NAPQI). Under physiological conditions, NAPQI is detoxified by glutathione (GSH) (Licata *et al.*, 2022). However, excessive paracetamol administration depletes hepatic glutathione stores, allowing NAPQI to covalently bind to cellular proteins and DNA. This process triggers oxidative stress, mitochondrial dysfunction, hepatocellular necrosis, and the subsequent release of SGPT into the bloodstream (Ramachandran, 2019)

In the present study, SGPT was selected as the primary biomarker for evaluating hepatoprotective activity because it is more specific for hepatocellular injury than other transaminase enzymes. SGPT is predominantly localized in the cytoplasm of hepatocytes and is released into the circulation when hepatocyte membrane integrity is compromised or cellular necrosis occurs. Therefore, elevated serum

SGPT levels reflect the extent of hepatic injury resulting from oxidative stress and hepatocellular inflammation, making SGPT a sensitive indicator for assessing paracetamol-induced liver damage (Li *et al.*, 2025)

Overall, the findings demonstrate that both plant extracts exhibited hepatoprotective activity against paracetamol-induced liver injury. However, the 70% ethanolic extract of Moringa oleifera leaves showed greater hepatoprotective efficacy than the 70% ethanolic extract of Elephantopus scaber leaves, as evidenced by a lower percentage increase in SGPT levels that was comparable to the effect of silymarin. These results suggest that Moringa oleifera leaf extract has superior potential as a natural hepatoprotective agent.

Statistical analysis using the Kruskal–Wallis test followed by the Mann–Whitney post hoc test demonstrated that the comparison between the group treated with 70% ethanolic extract of Moringa oleifera leaves and the positive control group receiving silymarin yielded a p-value of 0.513 ($p > 0.05$). This result indicates that there was no statistically significant difference between the two groups, suggesting that the hepatoprotective effect of the 70% ethanolic extract of Moringa oleifera leaves was comparable to that of silymarin. Furthermore, based on the percentage increase in SGPT levels following paracetamol induction, the Moringa oleifera-treated group exhibited only a relatively small increase in SGPT, indicating that the extract effectively prevented excessive elevation of SGPT induced by paracetamol. These findings suggest that the extract was capable of protecting hepatocytes against the hepatotoxic effects of the paracetamol metabolite, N-acetyl-p-benzoquinone imine (NAPQI), thereby minimizing liver cell injury and reducing the release of SGPT into the bloodstream.

The hepatoprotective activity is likely attributable to the presence of bioactive compounds, particularly flavonoids, quercetin, kaempferol, and other phenolic constituents, which possess potent antioxidant properties. These compounds scavenge reactive oxygen species, inhibit lipid peroxidation, enhance endogenous antioxidant defense systems, and preserve the integrity of hepatocyte membranes.(Majee *et al.*, 2023). Consequently, despite paracetamol induction, the increase in SGPT levels in the Moringa oleifera extract-treated group remained substantially lower than that observed in the negative control group and was not significantly different from the silymarin-treated group, indicating that the extract exhibits hepatoprotective efficacy comparable to the standard hepatoprotective agent, silymarin.

CONCLUSION

The 70% ethanolic extracts of Moringa oleifera and Elephantopus scaber contain bioactive flavonoid compounds that exhibit hepatoprotective activity by protecting hepatocytes against oxidative damage induced by free radicals, 70% Ethanolic Extracts of Moringa oleifera and Elephantopus scaber Leaves exhibited hepatoprotective activity; however, the ethanolic extract of Moringa oleifera leaves showed superior hepatoprotective efficacy and was comparable to silymarin in protecting against paracetamol-induced liver injury.

REFERENCES

Aghemo, A., Alekseeva, O. P., Angelico, F., Bakulin, I. G., Bakulina, N. V, Bordin, D., Bueverov, A. O., Drapkina, O. M., Gillessen, A., Kagarmanova, E. M., Korochanskaya, N. V, Lazebnik, L. B., Livzan, M. A., Maev, I. V, Anatolii, I., Osipenko, M. F., Sas, E. I., Starodubova, A., Yurii, P.,Yakovlev, A. A. (2022). Annals Of Medicine Role Of Silymarin As Antioxidant In Clinical Management Of Chronic Liver Diseases : A Narrative Review. *Annals Of Medicine*, *54*(1), 1548–1560.

Ainun, F., Wasdili, Q., Octaviani, C. D., & Furqon, A. (2022). Hubungan Lama Kerja Dengan Aktivitas Enzim Alkaline Phosphatase (Alp) Pada Petani Di Daerah Lembang Info Artikel. *Jurnal Analis Kesehatan Klinikal Sains Http://Jurnal.Univrab.Ac.Id/Index.Php/Klinikal*, *10*(2), 131–139.

Anindyaguna, A., Mustofa, S., Anggraini, D. I., Oktarlina, R. Z., Biokimia, B., Fakultas, M., Lampung, U., Ilmu, B., Kedokteran, F., & Lampung, U. (2022). Drug-Induced Liver Injury Akibat Penyalahgunaan Parasetamol Drug-Induced Liver Injury Due To Paracetamol Abuse. *Medula*, *12*, 500–507.

Cortés, M. G., & García, A. G. (2022). Management Of Pharmacologic Adverse Effects In Advanced Liver Disease. *Clinical Drug Investigation*, *42*(S1), 57–62.

Fontana, R. J., Liou, I., Reuben, A., Suzuki, A., Fiel, M. I., & Lee, W. (2023). Practice Guidance Aasld Practice Guidance On Drug , Herbal , And Dietary Supplement – Induced Liver Injury. *Hepatology*, *0*(July 2022), 1036–1065.

Gulo, K. N., & Saragih, A. D. (2021). Antioxidant Activity Of Flavonoid Compounds In Ethanol And Ethyl Acetate Extract From Citrus Sinensis. *International Conference On Artificial Intelligence And Mechatronics Systems*.

Hall, J. E. (2025). *Guyton And Hall Textbook Of Medical Physiology* (15 Th Edit). Philadelphia, Pennsylvania : Elsevier.

Jaeschke, H., & Ramachandran, A. (2024). Acetaminophen Hepatotoxicity : Paradigm For Understanding Mechanisms Of Drug-Induced Liver Injury. *Annual Review Ofpathology*, 453–478.

Li, R., Wu, H., Xu, Y. U. E., Xu, X., Xu, Y., & Huang, H. (2025). Underlying Mechanisms And Treatment Of Acetaminophen - Induced Liver Injury (Review). *Molecular Medicine Report*, 1–13.

Licata, A., Minissale, M. G., Stankevi, S., & Almasio, P. L. (2022). N-Acetylcysteine For Preventing Acetaminophen-Induced Liver Injury : A Comprehensive Review. *Frontiers In Pharmacology*, *13*(August).

Lin, D., Tang, Q., Zhuo, X., Wang, W., Li, C., Kuang, K., Wu, Z., Zhang, Y., Wang, G., Li, Y., Ã, D. L., Ã, Q. T., Zhuo, X., Wang, W., & Li, C. (2021). Three New Sesquiterpene Lactones From The Whole Plants Of Elephantopus Scaber Three New Sesquiterpene Lactones From The Whole Plants. *Natural Product Research*, *0*(0), 1–7.

Majee, C., Mazumder, R., & Choudhary, A. N. (2023). An Insight Into The Hepatoprotective Activity And Structure-Activity Rela- Tionships Of Flavonoids. *Mini Reviews In Medicinal Chemistry*, 131–149.

Meshack, S. (2022). A Review Of Plants With Remarkable Hepatoprotective Activity. *Journal Of Drug Delivery And Therapeutics Open*, *12*(1), 194–202.

Nawir Siti Hardiyanti, K. P. P. I. (2021). Efek Ekstrak Ethanol Daun Kelor (Moringa Oleifera) Terhadap Proteksi Fungsi Hati Dan Histopatologi Tikus Putih (Rattus Norvegicus) Yang Diinduksi Karbontetraklorida (Ccl4). *Journal Ilmiah Ecosiytem*, *21*(April).

Nguyen, T. H. P., & Phan, T. D. (2022). A Study On Antibacterial , Antioxidant , And Hepatoprotective Efficacy Of. *Sains Malaysiana*, *51*(12), 4031–4041.

Nugrahinim Lestari, Hardiana Iyan, Noor Mochamad Rifky Hasan, T. (2022). Jurnal Farmasi Kryonaut. *Jurnal Farmasi Kryonaut*, *1*(1), 17–22.

Nurhayati, T., Ridho, M. F., Teesa, P., Santoso, R., Setiawan, S., Goenawan, H., & Tarawan, V. M. (2024). Effects Of Moringa Oleifera Leaf Extract On Liver Histopathology : A Systematic Review. *Journal Of Nutrition And Metaboloism*, *2024*.

Prasuma, G. S., Qotrunnada, E. N., & Charisma, S. L. (2024). Uji Aktivitas Hepatoprotektor Ekstrak Etanol Herba Tapak Liman (Elephantopus Scaber L .) Terhadap Tikus Jantan Galur Wistar Yang Diinduksi Isoniazid Hepatoprotective Activity Of Ethanol Extract Of Tapak Liman (Elephantopus Scaber L .) Against Male Wista. *Jurnal Farmasi Indonesia (Pharmaceutical Journal Of Indonesia)*, *20*(02), 183–188.

Ramachandran, A. (2019). Acetaminophen Hepatotoxicity. *Seminars In Liver Disease.38*.

Suaskara Ida Bagus Made, Ermayanti Ni Gusti Ayu Maniki, Mantin Joni, Ginantr I Ketut, A. (2024). Aktivitas Teh (Air Seduhan) Daun Kelor Sebagai Hepatoprotektor Pada Tikus Putih Jantan Yang Diinduksi Formalin Dosis Toksik. *Simbiosis*, *1*, 94–99.

Younis, N., Khan, M. I., Zahoor, T., & Khalil, A. A. (2022). Phytochemical And Antioxidant Screening Of Moringa Oleifera For Its Utilization In The Management Of Hepatic Injury. *Frontiers In Nutrition*, *December*, 1–11.