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HEPATOPROTECTIVE POTENTIAL OF HYDROALCOHOLIC EXTRACT OF FICUS LYRATA AND FICUS ELASTIC LEAVES EXTRACT

Mrinal Aryan*[1] and Dr. Ashish Manigauha[2]

[1]Research Scholar, Faculty of Pharmacy, Mansarovar Global University Sehore (M. P.)
[2]Professor, Faculty of Pharmacy, Mansarovar Global University Sehore (M. P.)

***Corresponding Author: Mrinal Aryan**
Research Scholar, Faculty of Pharmacy, Mansarovar Global University Sehore (M. P.)

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ABSTRACT
The hepatoprotective potential of the hydroalcoholic extract of Ficus lyrata and Ficus elastic leaves was assessed in Albino rats that had been hepatotoxically treated with isoniazid and paracetamol. Biochemical indicators such serum glutamate pyruvate transaminase (SGPT), serum glutamate oxidase transaminase (SGOT), ALP, and total serum bilirubin level were estimated in order to gauge the level of protection. in rats that had been given paracetamol and isoniazid poisoning. In a dose-dependent fashion, hydroalcoholic extract (100 mg/kg, 200 mg/kg) showed a notable hepatoprotective effect. The hepatoprotective effects of the extract were comparable to those of silymarin 2.5 mg/kg body weight, the recommended medicine.

KEYWORDS: hepatoprotective potential, Ficus lyrata, Ficus elastic.

1. INTRODUCTION
Natural herbal remedies are often regarded as safe and efficient natural cures for a variety of ailments. This study aimed to illustrate Ficus elastic and lyrata's hepatoprotective, antioxidant, and initial chemical screening capabilities. The dried leaves material was properly cleaned under running water before being ground in an automated grinder. Using a mixture of ethanol and water as a solvent and the maceration process, the powder was gradually extracted. Ficus lyrata and Ficus elastic were assessed using a number of conventional criteria, including as yield, percentage loss, organoleptic evaluation, and phytochemical screening.

In traditional medicine, Ficus lyrata and Ficus elastic leaf are important medicinal plants that are used to treat a range of ailments. The liver may be considered the most important organ in drug toxicity for two reasons: first, it is a major site for the metabolism and elimination of foreign substances and functions as a functional barrier between the site of absorption and the systemic circulation; second, these properties make the liver a prime target for drug toxicity. Thus, liver damage brought on by drugs poses a serious clinical problem. Damage to the liver or impairment of its function can have a range of detrimental impacts on health since the liver is necessary for the detoxification and excretion of numerous endogenous and exogenous chemicals. Management of liver diseases is still a challenge to modern medicine.

2. METHODOLOGY
2.1 Selection of animals
In the present investigation, Swiss albino rats weighing 150–200 g were used. The animals were allowed two weeks to adjust before the study began. After that, they were maintained under standard laboratory conditions, which included a 12-hour light/dark cycle, a temperature of 25±2ºC, and a relative humidity of 45–65%. The animals received normal laboratory animal feed and unrestricted water over the course of the study. The protocol for animal experiments was explicitly approved by the Institution's Animal Ethical Committee. Acute oral toxicity was tested using Organization for Economic Co-operation and Development (OECD) guideline No. 420. (CPCSEA NO.1582/PO/Re/S/11/CPCSEA) During an overnight fast in this study, the Swiss albino rats had constant access to water. After the extract was administered orally at a dosage of 2000 mg/kg body weight, the animals were observed during the first 24 hours and then for the next 14 days for any abnormal behavior or death. Additional autonomic, neurological, and behavioral responses were seen.

2.2 Isoniazid and Paracetamol induced hepatoprotective activity of Leaves extract of *Ficus lyrata and Ficus elastic*
2.2.1 Experimental designs for *Ficus lyrata* leaves Extract Isoniazid induced hepatoprotective
Group –I: Normal control (Sterile distilled water ml/kg, p.o.)

Group –II: Isoniazid solutions were prepared in sterile distilled water (100 mg/kg, p.o.)
Group -III: *Ficus lyrata* Extract (100mg/kg, p.o.) + Isoniazid (100 mg/kg, p.o.)
Group –IV: *Ficus lyrata* Extract (200mg/kg, p.o.) + Isoniazid (100 mg/kg, p.o.)
Group –V: Silymarin (2.5 mg/kg, p.o.) + Isoniazid (100 mg/kg, p.o.)

The animals were divided into five groups, each consisting of six individuals. The first group was given 1 milliliter per kilogram of sterile distilled water. Group II was administered 100 mg/kg p.o. of isoniazid solutions. Group III got 100 mg/kg of hydroalcoholic leaf extract from Ficus lyrata, whereas Group IV received 200 mg/kg. Group 5 received silymarin (2.5 mg/kg p.o.) once day for 21 days. After 21 days, the animal was put under ether anesthesia to extract blood from the retroorbital plexus. The liver was then removed from the animal while it was still under ether anesthesia. Many biochemical analyses were carried out.

2.2.2 Experimental designs for *Ficus lyrata* leaves Extract Paracetamol induced hepatoprotective
Group –I: Normal control (Sterile distilled water ml/kg, p.o.)
Group –II: Paracetamol solutions were prepared in sterile distilled water (50 mg/kg, p.o.)
Group -III: *Ficus lyrata* Extract (100mg/kg, p.o.) + Paracetamol, (50 mg/kg, p.o.)
Group –IV: *Ficus lyrata* Extract (200mg/kg, p.o.) + Paracetamol, (50 mg/kg, p.o.)
Group –V: Silymarin (2.5 mg/kg, p.o.) + Paracetamol, (50 mg/kg, p.o.)

The animals were divided into five groups, each consisting of six individuals. The first group was given 1 milliliter per kilogram of sterile distilled water. Group II was administered 50 mg/kg p.o. of paracetamol solutions. Group III got 100 mg/kg of hydroalcoholic leaf extract from Ficus lyrata, whereas Group IV received 200 mg/kg. Group 5 received silymarin (2.5 mg/kg p.o.) once day for 21 days. After 21 days, the animal was put under ether anesthesia to extract blood from the retroorbital plexus. The liver was then removed from the animal while it was still under ether anesthesia. Many biochemical analyses were carried out.

2.2.3 Experimental designs for *Ficus elastic* leaves Extract Isoniazid induced hepatoprotective
Group –I: Normal control (Sterile distilled water ml/kg, p.o.)
Group –II: Isoniazid solutions were prepared in sterile distilled water (100 mg/kg, p.o.)
Group -III: *Ficus elastic* Extract (100mg/kg, p.o.) + Isoniazid (100 mg/kg, p.o.)
Group –IV: *Ficus elastic* Extract (200mg/kg, p.o.) + Isoniazid (100 mg/kg, p.o.)
Group –V: Silymarin (2.5 mg/kg, p.o.) + Isoniazid (100 mg/kg, p.o.)

The animals were divided into five groups, each consisting of six individuals. The first group was given 1 milliliter per kilogram of sterile distilled water. Group II was administered 100 mg/kg p.o. of isoniazid solutions. Group III got 100 mg/kg of hydroalcoholic Ficus elastic leaf extract, whereas Group IV received 200 mg/kg. Group 5 received silymarin (2.5 mg/kg p.o.) once day for 21 days. After 21 days, the animal was put under ether anesthesia to extract blood from the retroorbital plexus. The liver was then removed from the animal while it was still under ether anesthesia. Many biochemical analyses were carried out.

2.2.4 Experimental designs for *Ficus elastic* leaves Extract Paracetamol induced hepatoprotective
Group –I: Normal control (Sterile distilled water ml/kg, p.o.)
Group –II: Paracetamol solutions were prepared in sterile distilled water (50 mg/kg, p.o.)
Group -III: *Ficus elastic* Extract (100mg/kg, p.o.) + Paracetamol, (50 mg/kg, p.o.)
Group –IV: *Ficus elastic* Extract (200mg/kg, p.o.) + Paracetamol, (50 mg/kg, p.o.)
Group –V: Silymarin (2.5 mg/kg, p.o.) + Paracetamol, (50 mg/kg, p.o.)

The animals were divided into five groups, each consisting of six individuals. The first group was given 1 milliliter per kilogram of sterile distilled water. Group II was administered 50 mg/kg p.o. of paracetamol solutions. Group III got 100 mg/kg of hydroalcoholic Ficus elastic leaf extract, whereas Group IV received 200 mg/kg. Group 5 received silymarin (2.5 mg/kg p.o.) once day for 21 days. After 21 days, the animal was put under ether anesthesia to extract blood from the retroorbital plexus. The liver was then removed from the animal while it was still under ether anesthesia. Many biochemical analyses were carried out.

3. RESULT AND DISCUSSION

Both test groups—the high dose and low dosage treatment groups—exhibited a dose-dependent hepatoprotective effect. The test groups that were given solely the plant extract showed an improvement in liver activity. The hepatoprotective qualities of "Ficus lyrata and Ficus elastic leaves" are clearly present. This study found that Ficus lyrata and Ficus elastica leaves considerably lessen the hepatotoxicity brought on by the drugs used to treat TB. Because of their antioxidant properties, Ficus lyrata and Ficus elastic leaves may have a hepatoprotective effect, suggesting that plant extract may be useful in avoiding oxidative stress-induced liver damage.

Following APAP-induced hepatotoxicity, elevated blood levels of SGPT, SGOT, and ALP activities signify hepatocyte damage to the liver and, consequently, indirect impairment of liver function. As indicated in Table, SGPT, SGOT, and ALP activities increased significantly ($p<0.05$) after APAP administration.

Treatments with Ficus lyrata and Ficus elastic leaf extract at 100 and 200 mg/kg significantly reduced the rise in these enzymes ($p<0.05$). The observed reduction in liver enzymes was similar to that of the silymarin-pretreated group and the control group. One of the most common signs of hepatic injury or damage is the apparent leaking of cellular enzymes into plasma.

Furthermore, the kind and degree of liver injury may be ascertained by looking at the presence or absence of certain enzymes in the circulation. In general alanine aminotransferase measures to evaluate APAP-induced hepatotoxicity, alkaline phosphatase, aspartate aminotransferase, and alanine aminotransferase are commonly used as marker enzymes. The hepatoprotective effect of Ficus lyrata and Ficus elastic leaves is demonstrated by the improvement in SGPT, SGOT, ALP, and serum bilirubin levels seen in this study. Isoniazid, paracetamol, Ficus lyrata, and Ficus elastic leaf extract all reduce the rise in serum bilirubin. Previous studies have demonstrated an increase in transaminase levels after isoniazid medication. (Reddy et al., 2013). The rise is time-dependent, showing a substantial increase after 48 hours ($p<0.05$), suggesting that these normally cytoplasmic enzymes are causing serious hepatocellular damage by seeping into the circulation. (Asha, *et al.*, 2004).

3.1 Hepatoprotective activity of *Ficus lyrata* leaves extract in Isoniazid induced hepatotoxicity

In rats with isoniazid-induced hepatotoxicity, the hydroalcoholic extract of Ficus lyrata leaves and silymarin showed hepatoprotective effects on the percentages of SGOT, SGPT, serum bilirubin, and ALP. 3.1, 3.2, 3.3, and 3.4. Findings about the hepatoprotective effects of a hydroalcoholic extract of Ficus elastic leaves and silymarin on the percentages of SGOT, SGPT, serum bilirubin, and ALP levels in rats with isoniazid-induced hepatotoxicity 3.5, 3.6, 3.7, and 3.8.

Table 3.1: Effect of Hydroalcoholic extract of *Ficus lyrata* leaves and Silymarin on % SGOT levels in Isoniazid induced hepatotoxicity in rats.

Treatment	Dose	SGOT (%)
Normal	1 ml/kg, p.o.	162 ± 2.5
Isoniazid	100 mg/kg, p.o.	341.45 ± 6.5
Ficus lyrata leaves	100 mg/kg p.o.	214.0 ± 3.0***
Ficus lyrata leaves	200 mg/kg p.o.	189.0 ± 3.5***
Silymarin	2.5 mg/kg p.o.	168.0 ± 2.9***

Table 3.2: Effect of Hydroalcoholic extract of *Ficus lyrata* leaves Fruits and Silymarin on %SGPT levels in Isoniazid induced hepatotoxicity in rats.

Treatment	Dose	SGPT (%)
Normal	1 ml/kg, p.o.	160.0 ± 2.0
Isoniazid	100 mg/kg, p.o.	321.0 ± 3.50
Ficus lyrata leaves	100 mg/kg p.o.	194.0 ± 4.0***
Ficus lyrata leaves	200 mg/kg p.o.	179.0 ± 3.50***
Silymarin	2.5 mg/kg p.o.	155.0 ± 3.50***

Table 3.3: Effect of *Ficus lyrata* leaves and Silymarin on % serum bilirubin levels in Isoniazid induced hepatotoxicity in rats.

Treatment	Dose	Serum Bilirubin (%)
Normal	1 ml/kg, p.o.	120.0 ± 5.50
Isoniazid	100 mg/kg, p.o.	285.0 ± 3.50
Ficus lyrata leaves	100 mg/kg p.o.	159.0 ± 4.51***
Ficus lyrata leaves	200 mg/kg p.o.	129.0 ± 1.60***
Silymarin	2.5 mg/kg p.o.	115.0 ± 4.50***

Table 3.4: Effect of *Ficus lyrata* leaves and Silymarin on % ALP levels in Isoniazid induced hepatotoxicity in rats.

Treatment	Dose	ALP (%)
Normal	1 ml/kg, p.o.	162.0 ± 3.20
Isoniazid	100 mg/kg, p.o.	325.0 ± 5.57
Ficus lyrata leaves	100 mg/kg p.o.	219.0 ± 4.30***
Ficus lyrata leaves	200 mg/kg p.o.	186.0 ± 3.78***
Silymarin	2.5 mg/kg p.o.	170.0 ± 5.40***

3.2 Hepatoprotective activity of *Ficus elastic* leaves extract Isoniazid induced hepatotoxicity

Table 3.5: Effect of Hydroalcoholic extract of *Ficus elastic* leaves and Silymarin on % SGOT levels in Isoniazid induced hepatotoxicity in rats.

Treatment	Dose	SGOT (%)
Normal	1 ml/kg, p.o.	160 ± 2.5
Isoniazid	100 mg/kg, p.o.	328.45 ± 6.5
Ficus elastic leaves	100 mg/kg p.o.	205.0 ± 3.5***
Ficus elastic leaves	200 mg/kg p.o.	177.0 ± 3.5***
Silymarin	2.5 mg/kg p.o.	165.0 ± 2.5***

Table 3.6: Effect of Hydroalcoholic extract of *Ficus elastic* leaves and Silymarin on %SGPT levels in Isoniazid induced hepatotoxicity in rats.

Treatment	Dose	SGPT (%)
Normal	1 ml/kg, p.o.	155.0 ± 2.0
Isoniazid	100 mg/kg, p.o.	321.0 ± 3.50
Ficus elastic leaves	100 mg/kg p.o.	188.0 ± 4.0***
Ficus elastic leaves	200 mg/kg p.o.	165.0 ± 3.50***
Silymarin	2.5 mg/kg p.o.	162.0 ± 3.50***

Table 3.7: Effect of *Ficus elastic* leaves and Silymarin on % serum bilirubin levels in Isoniazid induced hepatotoxicity in rats.

Treatment	Dose	Serum Bilirubin (%)
Normal	1 ml/kg, p.o.	120.0 ± 5.50
Isoniazid	100 mg/kg, p.o.	274.0 ± 3.50
Ficus elastic leaves	100 mg/kg p.o.	147.0 ± 4.81***
Ficus elastic leaves	200 mg/kg p.o.	123.0 ± 1.50***
Silymarin	2.5 mg/kg p.o.	113.0 ± 4.50***

Table 3.8: Effect of *Ficus elastic* leaves and Silymarin on % ALP levels in Isoniazid induced hepatotoxicity in rats.

Treatment	Dose	ALP (%)
Normal	1 ml/kg, p.o.	162.0 ± 3.20
Isoniazid	100 mg/kg, p.o.	340.0 ± 5.57
Ficus elastic leaves	100 mg/kg p.o.	215.0 ± 4.30***
Ficus elastic leaves	200 mg/kg p.o.	178.0 ± 3.78***
Silymarin	2.5 mg/kg p.o.	167.0 ± 5.40***

3.3 Hepatoprotective activity of *Ficus lyrata* leaves extract Paracetamol induced hepatotoxicity model

Hepatoprotective effects of Ficus lyrata leaf extract and paracetamol on the percentages of SGOT, SGPT, serum bilirubin, and ALP levels in rats with paracetamol-induced hepatotoxicity. The effects of the hydroalcoholic extract of Ficus elastic leaves and silymarin on the percentage of SGOT levels in rats with paracetamol-induced hepatotoxicity are shown in Tables 3.9, 3.10, 3.11, and 3.12. 3.13, 3.14, 3.15, and 3.16 tables.

Table 3.9: Effect of Hydroalcoholic extract of *Ficus lyrata* leaves and Silymarin on % SGOT levels in Paracetamol induced hepatotoxicity in rats.

Treatment	Dose	SGOT (%)
Normal	1 ml/kg, p.o.	158 ± 2.5
Paracetamol	50 mg/kg, p.o.	352.45 ± 6.5
Ficus lyrata leaves	100 mg/kg p.o.	227.0 ± 3.5***
Ficus lyrata leaves	200 mg/kg p.o.	203.0 ± 3.0***
Silymarin	2.5 mg/kg p.o.	179.0 ± 3.5***

Table 3.10: Effect of Hydroalcoholic extract of *Ficus lyrata* leaves and Silymarin on %SGPT levels in Paracetamol induced hepatotoxicity in rats.

Treatment	Dose	SGPT (%)
Normal	1 ml/kg, p.o.	151.0 ± 2.0
Paracetamol	50 mg/kg, p.o.	316.0 ± 3.50
Ficus lyrata leaves	100 mg/kg p.o.	189.0 ± 4.0***

Ficus lyrata leaves	200 mg/kg p.o.	174.0 ± 3.50***
Silymarin	2.5 mg/kg p.o.	152.0 ± 3.50***

Table 3.11: Effect of *Ficus lyrata* leaves and Silymarin on % serum bilirubin levels in Paracetamol induced hepatotoxicity in rats.

Treatment	Dose	Serum Bilirubin (%)
Normal	1 ml/kg, p.o.	122.0 ± 5.50
Paracetamol	50 mg/kg, p.o.	304.0 ± 3.50
Ficus lyrata leaves	100 mg/kg p.o.	201.0 ± 4.51***
Ficus lyrata leaves	200 mg/kg p.o.	165.0 ± 1.60***
Silymarin	2.5 mg/kg p.o.	125.0 ± 4.50***

Table 3.12: Effect of *Ficus lyrata* leaves and Silymarin on % ALP levels in Paracetamol induced hepatotoxicity in rats.

Treatment	Dose	ALP (%)
Normal	1 ml/kg, p.o.	155.0 ± 3.20
Paracetamol	50 mg/kg, p.o.	337.0 ± 5.57
Ficus lyrata leaves	100 mg/kg p.o.	232.0 ± 4.30***
Ficus lyrata leaves	200 mg/kg p.o.	191.0 ± 3.78***
Silymarin	2.5 mg/kg p.o.	175.0 ± 5.40***

3.4 Hepatoprotective activity of *Ficus elastic* leaves extract Paracetamol induced hepatotoxicity model

Table 3.13: Effect of Hydroalcoholic extract of *Ficus elastic* leaves and Silymarin on % SGOT levels in Paracetamol induced hepatotoxicity in rats.

Treatment	Dose	SGOT (%)
Normal	1 ml/kg, p.o.	165 ± 2.5
Paracetamol	50 mg/kg, p.o.	339.45 ± 6.5
Ficus elastic leaves	100 mg/kg p.o.	219.0 ± 3.5***
Ficus elastic leaves	200 mg/kg p.o.	181.0 ± 3.5***
Silymarin	2.5 mg/kg p.o.	168.0 ± 2.5***

Table 3.14: Effect of Hydroalcoholic extract of *Ficus elastic* leaves and Silymarin on %SGPT levels in Paracetamol induced hepatotoxicity in rats.

Treatment	Dose	SGPT (%)
Normal	1 ml/kg, p.o.	152.0 ± 2.0
Paracetamool	50 mg/kg, p.o.	314.0 ± 3.50
Ficus elastic leaves	100 mg/kg p.o.	196.0 ± 4.0***
Ficus elastic leaves	200 mg/kg p.o.	174.0 ± 3.50***
Silymarin	2.5 mg/kg p.o.	156.0 ± 3.50***

Table 3.15: Effect of *Ficus elastic* leaves and Silymarin on % serum bilirubin levels in Paracetamol induced hepatotoxicity in rats.

Treatment	Dose	Serum Bilirubin (%)
Normal	1 ml/kg, p.o.	120.0 ± 5.50
Pacetamol	50 mg/kg, p.o.	290.0 ± 3.50
Ficus elastic leaves	100 mg/kg p.o.	155.0 ± 4.81***
Ficus elastic leaves	200 mg/kg p.o.	131.0 ± 1.50***
Silymarin	2.5 mg/kg p.o.	125.0 ± 4.50***

Table 3.16: Effect of *Ficus elastic* leaves and Silymarin on % ALP levels in Paracetamol induced hepatotoxicity in rats.

Treatment	Dose	ALP (%)
Normal	1 ml/kg, p.o.	162.0 ± 3.20
Paracetamol	50 mg/kg, p.o.	331.0 ± 5.57
Ficus elastic leaves	100 mg/kg p.o.	227.0 ± 4.30***
Ficus elastic leaves	200 mg/kg p.o.	172.0 ± 3.78***
Silymarin	2.5 mg/kg p.o.	165.0 ± 5.40***

CONCLUSION

The primary barrier to therapeutic development and a primary cause of pharmaceutical companies ceasing to offer their products is hepatic damage. Medication-induced liver disease can be either unusual (rare and likely dose related) or predictable (frequent and likely measurement related). Eccentric (also known as odd) responses can be categorized as resistant or non-immune to high touchiness. People have used plants to treat ailments, promote long-term good health, ease extreme suffering, and enhance the flavor and aroma of food since ancient times. For almost 5,000 years, China and India have employed a plant-based human services framework. In Europe, botanicals were widely utilized as medicines until around 50 years ago.

Ancient advances from China, India, and Greece were independently incorporated into the pharmacological systems of the Arabic countries. But in terms of study depth and range, the Ayurvedic framework is the most unmatched. It is considered to be one of the earliest prescription systems, having begun about 6000 BC. Medicinal plants are now an essential part of conventional medical systems in many nations. It is necessary to document the examination work performed on conventional drugs. Identification of plant material is aided by these researches. Natural medications dominated the therapeutic scene in the middle of the 20th century when synthetic analgesics and antibacterial medications were not yet generally accessible. When allopathic pharmaceutical arrangements for produced pharmaceuticals quickly acquired popularity and provided quicker symptom alleviation, people started to move to this framework.

REFERENCE

1. Hassan Abdalla Almahyl, Mawardi Rahmani%, Mohd Aspollah SukarP & Abdul Manaf Ali4, Investigation on the Chemical Constituents of the Leaves of Ficus elastica Roxb. and Their Antimicrobial Activity, Pertanika J. Sci. & Technol, 2003; 11(1): 57 – 63.
2. Jean Emmanuel Mbosso Teinkela Xavier Siwe Noundou Edwige Laure Nguemfo Franck Meyer Rene Wintjens Michelle Isaacs Albert Emmanuel Mpondo Mpondo Heinrich C. Hoppe Rui Werner Maçedo Krause and Anatole Guy Blaise Azebaze Biological activities of plant extracts from *Ficus elastica* and *Selaginella vogelli*: An antimalarial, antitrypanosomal and cytotoxity evaluation. Saudi J Biol Sci., 2018 Jan; 25(1): 117–122. Published online 2017 Jul 20. doi: 10.1016/j.sjbs.2017.07.002
3. Keppler D, Lesch R, Reutter W, Decker K. Experimental hepatitisinducedbyd-galactosamine. ExpMolPathol, 1968 Oct; 9(2): 279-90.
4. Khandelwal KR. Ed. Practical Pharmacognosy Technique and Experiments, 23rd Edn: 2005; 15.
5. Kokate CK. Ed. Practical Pharmacognosy, 4th Edn., *Vallabh Prakashan*: 1994; 112: 120.
6. KulikovaO.(2015), Hepatoprotective Activity of Plant Peptides, Ame. J. of Plant Sci., 6: 848-55.
7. Levy SB, Marshall B. Antibacterial resistance worldwide: causes, challenges and responses. Nature Medicine Supplement, 2007; 10(12): 122-129.
8. M. P. Gonthier, C. Remesy, A. Scalbert, V. Cheynier, J. M. Souquet, K. Poutanen, and A. M. Aura, "Microbial metabolism of caffeic acid and its esters chlorogenic and caftaric acids by human faecal microbiota *in vitro*," *Biomedicine & Pharmacotherapy*, 2006; 60: 536-540.
9. Mcintyre N, Benhamou JP, Bircher J, Rizzetto M, Rodes J. Oxfordtext book of clinical hepatology. Vol 2. 2nd ed. New York: Oxford University Press, 1991; 907-09.
10. Mohd Mujeeb, Shah Alam Khan, Vidhu Aeri, and Babar Ali, Hepatoprotective Activity of the Ethanolic Extract of *Ficus carica* Linn. Leavesin Carbon Tetrachloride-Induced Hepatotoxicityin Rats, Iran J Pharm Res., 2011 Spring; 10(2): 301–306.
11. Nadeem M. etal., (1996), "Hepatoprotective activity of some herbal formulations in India". Indian Drugs, 33(8): 390-395.
12. OECD, Guideline for Testing of Chemicals-Acute Oral Toxicity-Acute Toxic Class Method. Paris: OECD; 2001.
13. Reddy KN, Subbaraju GV, Reddy CS, Raju VS. Ethnoveterinary medicine for treating livestock in Eastern Ghats of Andhra Pradesh. Indian Journal of Tradition Knowledge, 2013; 5(3): 368-378.