IJNRD.ORG ISSN : 2456-4184
INTERNATIONAL JOURNAL OF NOVEL RESEARCH AND DEVELOPMENT (IJNRD) | IJNRD.ORG
An International Open Access, Peer-reviewed, Refereed Journal

Hepatoprotective and antioxidant potential of Cuscuta Reflexa Roxb in PCM induced mice

Yadveer Singh, Dr.Pankaj Arora ,Om Prakash Sharma

Lords University Alwar

ABSTRACT: *Cuscuta Reflexa Roxb.* belongs to the family Convolvulaceae is found in Indomalaysia, Srilanka, indigenous to Chattishgarh, Bangal, Karnataka and Rajasthan in India. The main active principle present in the plant is cuscutin, Cuscutalin and reducing sugar. Amarvelin, resin oil (3%), reducing sugars, fatty acid and phytosterol are all present in the seeds. Cuscutin, dulcitol, luteolin, quercetin and luteolin glycoside are all present in the stem. It is described as an expectorant, an anti-inflammatory, a blood purifier and a pain reliever in Indian traditional medicine. Hepatoprotective action may be caused by flavonoid content. On the other hand, there is no information accessible regarding Cuscuta Reflexa Roxb activity against in-vivo antioxidant activities and PCM-induced hepatotoxicity tests. Therefore, the current effort has been conducted to evaluate the ethanolic extract of Cuscuta Reflexa Roxb's hepatoprotective and antioxidant properties. on swiss albino mice activity produced by PCM. In-vitro hydroxyl, nitric oxide, lipid peroxidation and DPPH scanning activities further support this.

Key words: *Cuscuta Reflexa Roxb.* Hepatoprotective, Anti-oxidant, PCM and Hepatic injury

Abbreviations: SOD(Super oxide dismutase), CAT(Catalase), NO(Nitric oxide)

1. Introduction:

The liver is an extremely significant organ since it controls a wide range of other bodily processes. It is crucial to several functions, including secretion, metabolism and storage. It is able to develop useful principles, which gives it the ability to regulate the chemical composition of its own body in a very effective manner. It possesses the ability to do this. Carbon tetrachloride (CCl_4), paracetamol, nitrosamine, polycyclic aromatic hydrocarbons and drinking an excessive amount of alcohol are all examples of substances that are harmful to the liver[1].The translocation of Bax and dynamin-related protein 1 (Drp1) into mitochondria is caused by mitochondrial oxidative stress. Once within mitochondria, these proteins are responsible for mitochondrial fission and eventually initiate the mitochondrial membrane permeability transition (MPT). Apoptosis inducing factor (also known as AIF) and endonuclease G are two examples of the intermembrane proteins that are initially released into the cytosol as a direct consequence of the creation of MPT. They go to the nucleus and damage the nuclear DNA Fragmentation which then triggers the process of controlled necrosis. Because of the possibility that it might stop free radicals from damaging cells all over the body, research into natural antioxidants has recently seen a boom in popularity[2]. They are necessary for maintaining good health and may be found in a wide variety of plant-based foods such as fruits and vegetables[3].To treat and prevent hepatotoxicity brought on by drugs and chemicals, many different

techniques have been tried, all of which are found on the idea of antioxidants. The quest for unprocessed medications of botanical origin that include antioxidants has been one of the primary focuses of recent hepatoprotection research[4].

2.PLANT PROFILE :-

Fig:1 *Cuscuta Reflexa* Roxb

Scientific Name : *Cuscuta Reflexa* Roxb,

Family : Convolvulaceae

Chemical constituents: cuscutalin & cuscutin flavonoids

Medicinal uses: Hepatic Injury, liver indurations and jaundiceM

3. MATERIALS AND METHODS:

EXPERIMENTAL ANIMALS:

Swiss albino mice, both male and female, weighing between 25 and 30 grammes apiece, were used in the study. For the purpose of performing study on them, The Bilwal Medchem and Research Laboratory Pvt.Ltd provide animal facility to their needs. The temperature was set at 23°C, the humidity at 50%, and the light and dark cycles were repeated every 12 hours to protect the animals' health. Before the experiment began, the animals were all allowed a week to become accustomed to their new surroundings. After being randomly allocated to an experimental or control group, the mice were housed individually in sterile polypropylene cages with sterile rice husk as bedding. Consistent pellets served as their primary food supply and water was available without restriction. To lessen the effects of stress not directly related to the experiment, we gave the animals 48 hours to acclimate to the lab before beginning the treatment. Bilwal medchem and research laboratory Pvt.Ltd. has an approval of IAEC (Institutional Animal Ethical Committee). The use of animals in research was authorised by (REG.No.-2005/PO/RcBT/S/18/CPCSEA). The Committee for the Purpose of Control and Supervision of Experiments on Animals of the Government of India was the entity responsible for drafting these regulations (CPCSEA).

PLANT MATERIAL

Plant materials :

The whole plant of **Cuscuta Reflexa Roxb.** was authenticated by the scientist-E&Head of office Vinod Maina from BSI, Jodhpur (Rajasthan) and the reference number is (BSI/AZRC/1.12012/Tech./2021-22(PI.Id.)/155.

Methods

Plant collection and extract preparation:

- Approximately 3 kilogrammes (3 kg) of plant material was gathered from the area around Dausa, District, Rajasthan (India), and allowed to dry at room temperature for about two months.
- Preparation of the extracts: After proper drying of the plant, the plant was coarsely powdered for extraction process.
- The coarsely powdered plant Cuscuta Reflexa Roxb. was extracted with 90% ethanol solution in soxhlet extractor batchwise till discolouration of the powdered drug appears.
- After the extraction of the whole coarsely powdered drug, it was filtered and further carried out for distillation process by using distillator to remove liquid present in the extract.
- After distillation process, the extract was concentrated on hot plate to remove moisture.
- Then the extract was stored in the desiccator to protect from moisture and contamination for preliminary qualitative phytochemical investigation and pharmacological investigation.
- The yield of the corrosive extracts was determined as a percentage. The colour and consistency of ethanolic extract was noted which has been summarized in table

Percentage extractives and physical characteristic of ethanolic extract of Cuscuta Reflexa Roxb

Table :1

Solvent	Plant	Colour and consistency	% yield(W/W)
Ethanol	Cuscuta Reflexa Roxb	Dark grayish & sticky	6.80

4.PHARMACOLOGICAL EVALUATION

Acute Toxicity Study[5]:

According to the OECD's requirements 15-day acute toxicity study using Swiss albino mice of both sexes and weighing 25–30 g was conducted to examine the effects of Cuscuta Reflexa Roxb. The animals spent the full night without food or water before taking part in the experiment. When evaluating acute toxicity, the up-and-down approach was used. As part of acute toxicity studies, Cuscuta Reflexa Roxb ethanolic extract was administered to animals, but neither toxicity symptoms nor animal deaths were observed. This led researchers to conclude that even at the greatest dose of 2,000 milligrammes per kilogramme of body weight, the substance was not lethal. The extract's hepatoprotective and antioxidant activities were evaluated at doses of 200 mg/kg and 100 mg/kg body weight, or 1/10th and 1/20th of the whole dose respectively.

EXPERIMENTAL DESIGN FOR SCREENING MODEL PARACETAMOL:

Group -1: Normal Control mice treated with 0.9% NaCl [2 ml/kg day]

Group-2: Mice treated with (60 mg paracetamol/kg P.O with tween 80)

Group -3: Mice treated with *Silymarin* (50 mg/ kg p.o) + paracetamol .

Group -4: Mice treated with *Cuscuta Reflexa* alone (200mg/kg p.o)

Group -5: Mice treated with *Cuscuta Reflexa* (100mg/kg p.o) + paracetamol

Group-6: Mice treated with *Cuscuta Reflexa* (200mg/kg p.o) + paracetamol

PROCEDURE[6,7]

Animals were as shown above grouped and treated for a period of 21 days. On 17th day, paracetamol (60mg/kg p.o) in tween 80 was administered to all groups other than group I and IV. Group III received standard drug silymarin 50 mg/kg p.o. once in a day and paracetamol as mentioned above. Where as group IV, V and VI were treated with test extract dose of (200,100, 200 mg/kg p.o.) respectively. During this period of treatment the mice were maintained under normal diet and water. All the animals were sacrificed 72 hrs, after the administration of paracetamol i.e. on 21st day. Blood was collected by retro orbital bleeding(puncture) under mild ether anesthesia. Blood was allowed to clot at room temperature for 30 min, subjected to centrifugation (3000 rpm for 15 min.) and subjected to biochemical parameters.

Liver was dissected out and subjected for morphological study such as wet liver weight of each animal. Further the liver was placed in 10% formalin solution for histopathological study. Then the 10% of liver homogenate was subjected for in-vivo antioxidant estimation.

ESTIMATION OF BIOCHEMICAL PARAMETERS:

ESTIMATION OF SERUM SGPT/ALT, SGOT/AST, SERUM ALKALINE PHOSPHATE (ALP) AND BILIRUBIN

ANTIOXIDANT ESTIMATION:

ESTIMATION OF TOTAL PROTEIN (TP), *GLUTATHIONE (GSH)*, TOTAL THIOLS, *LIPID PEROXIDATION*, CATALASE AND SOD

STUDIES ON IN-VITRO STEADY-STATE FREE RADICAL SCAVENGING (PCM):

Reaction with DPPH radical, hydroxyl radical, Lipid peroxidation (Lpx) assay and Nitric oxide

5.RESULT:

Researchers investigated the phytochemical and pharmacological qualities of an extract made from the entire plant of Cuscuta Reflexa Roxb for the purpose of this study. The following details are derived from the ongoing inquiry that's being carried out.

Phytochemical investigation:

Preparation of extract and properties:

The use of ethanol as a solvent in the soxhelt extraction method led to a significant increase in the percentage of powdered whole-plant extract that was obtained. The yield was 6.80 percent and the colour of the ethanolic extract was a dark greyish brown.

Preliminary Phytochemical Studies:
The results of a qualitative chemical analysis done on an ethanolic extract of the whole plant of Cuscuta Reflexa Roxb are presented in Table 5.1. This analysis was carried out for the presence of components. Based on this information, we may infer that the extract has the following components: flavonoids, glycosides, protein, triterpinoid, alkaloid, steroids and saponins.

ASSESSMENT OF HEPATOPROTECTIVE EFFECTS:

Table:2

Before and after the injection of an ethanolic extract of Cuscuta Reflexa Roxb, the levels of the hepatotoxic enzymes aspartate aminotransferase (AST), alanine aminotransferase (ALT), alanine aminopeptidase (ALP), total & direct bilirubin were evaluated in the blood serum of PCM induced hepatotoxicity.

Treatment	Liver weight in g	AST IU/L	ALT IU/L	ALP IU/L	Total Bilirubin mg/dl	Direct Bilirubin mg/dl
Normal	1.729 ±0.165	80.30 ±3.15***	45.70 ±0.55***	102.42 ±3.02***	1.100 ±0.019***	0.244 ±0.035**
PCM	2.110 ±0.2038	232.51 ±5.32	201.35 ±4.02	185.7 ±5.41	4.611 ±0.004	1.785 ±0.635
Silymarin+PCM	1.578 ±0.158	89.11 ±0.49***	53.43 ±1.02***	123.3 ±1.01***	1.254 ±0.018***	0.608 ±0.026*
EtOH-200 alone	1.743 ±0.1134	82.36 ±2.10***	44.82 ±0.84***	104.65 ±2.32***	1.076 ±0.003***	0.309 ±0.008**
EtOH-100+PCM	1.474 ±0.1333	100.43±2.11***	63.21±2.11***	135.44±1.01***	1.485±0.002***	0.690±0.056
EtOH-200+PCM	1.432 ±0.0879	95.11 ±1.05***	56.05 ±0.83***	124.24 ±2.02***	1.332 ±0.030***	0.599 ±0.011*
df=5	n=6	n=6	n=6	n=6	n=6	n=6
Confidencelevel	99%	99%	99%	99%	99%	99%

The values show the Mean ±SEM. When compared to the PCM group, the significance levels for the following tests are *P<0.01, **P<0.001, and ***P<0.0001. Dunnett's multiple comparison test after a one-way analysis of variance

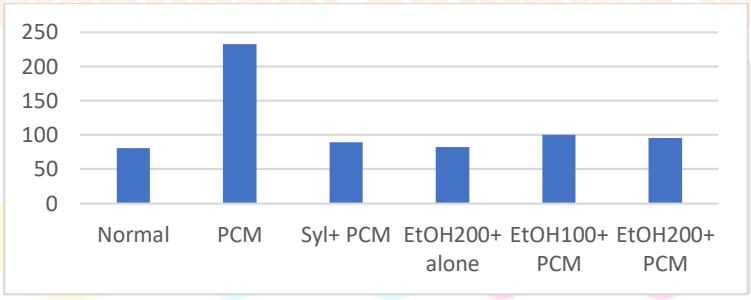

Fig.2 AST levels in various groups

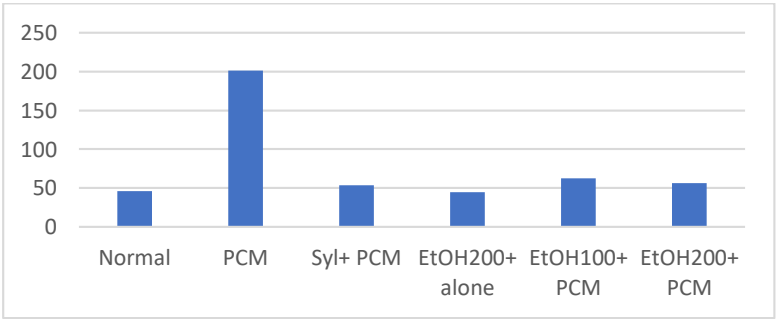

Fig.3 ALT levels in various groups

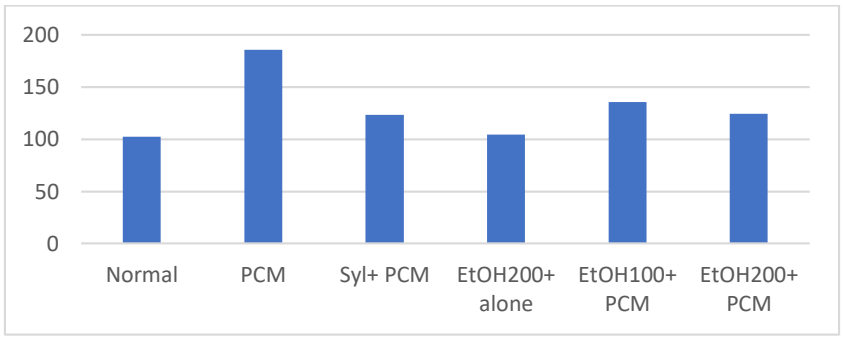

Fig.4ALP levels in various groups

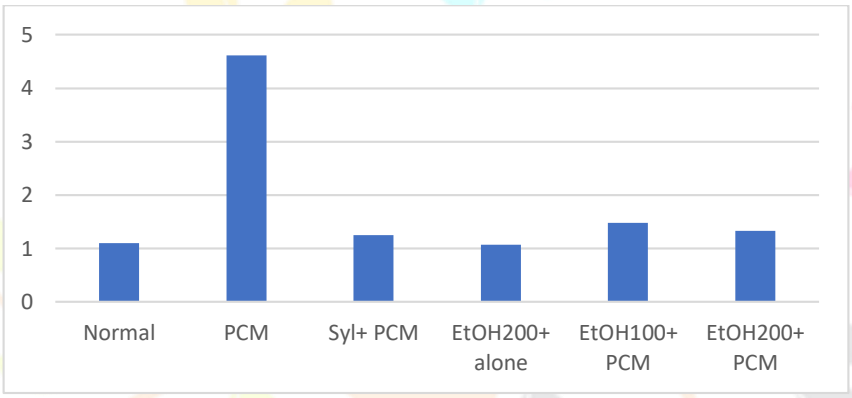

Fig.5Total Bilirubin levels in various groups

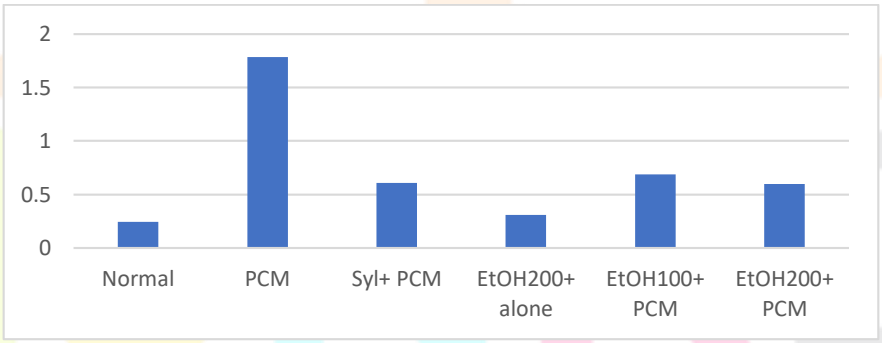

Fig.6 Direct Bilirubin in various groups

Evaluation of Antioxidant activity:

Antioxidant and free radical effect of ethanolic extract of Cuscuta Reflexa Roxb in PCM induced hepatotoxicity Table

Table 3

Endogenous antioxident effect of ethanolic extract of *Cuscuta Reflexa Roxb*. on tissue Total protein, GSH, Total thiol, Catalase, LPO and SOD in PCM induced hepatotoxicity.

Treatment	Total Protein	GSH nmol/mg of protein	Total Thiol nmol/mg of protein	CAT unit/mg protein	LPO unit/mg protein	SOD unit/mg of protein

	mg/100mg of wet tissue					
Normal	42.52±0.8384***	24.42±0.8555***	83.86±0.6266***	187.5±0.8830***	3.258±0.2626***	42.53±0.8811***
PCM	10.3±0.8813	11.53±0.8565	38.47±0.9595	51.52±0.96516	54.33±1.017	11.48±0.8801
Syl+ PCM	33.48±1.014***	22.44±0.9101***	74.35±1.00***	143.4±0.9583***	7.49±0..2643***	37.33±0.8950***
EtOH200 alone	37.42±0.8780***	25.43±0.9212***	76.63±1.02***	186.3±1.035***	4.88±0.1403***	40.62±1.014***
EtOH100+ PCM	24.22±1.029***	18.17±1.000***	66.55±0.795***	107.2±0.896***	9.13±0.4213***	28.41±0.9986***
EtOH200+ PCM	33.23±1.117***	21.4±0.8701***	72.72±0.870***	136.3±0.9385***	8.553±1.175***	36.2±0.9442***
df=5	n=6	n=6	n=6	n=6	n=6	n=6
Confidence level	99%	99%	99%	99%	99%	99%

Each value represents Mean ± SEM. *P<0.01; **p<0.001; ***p<0.0001compared to PCM group. One way ANOVA followed by Dunnett.'s multiple comparison test

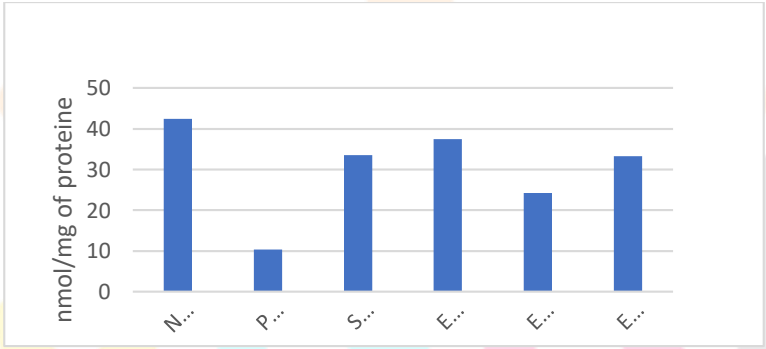

Fig.7 Total Protein levels in various groups

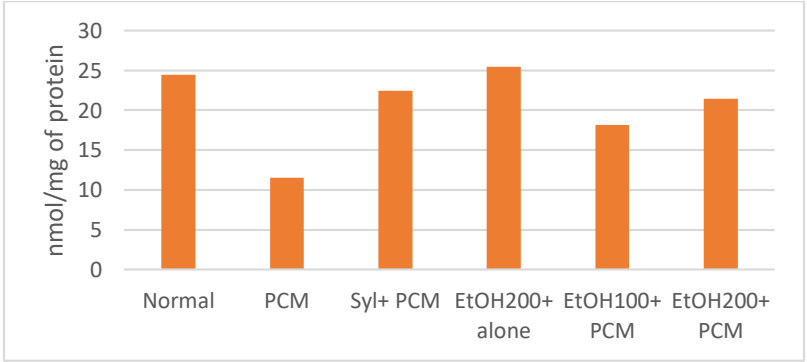

Fig.8 GSH levels in various groups

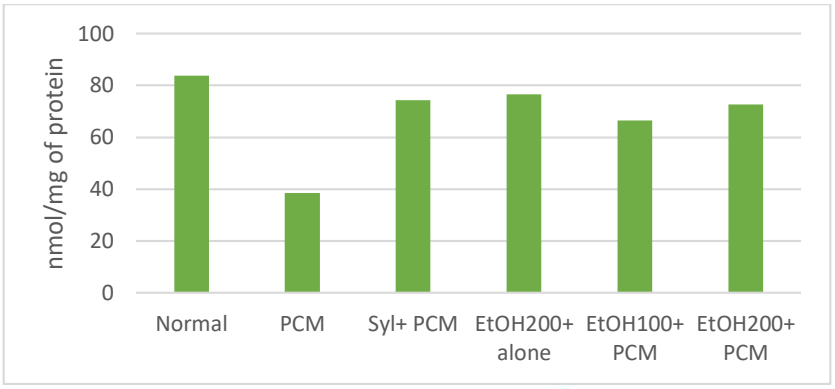

Fig.9 Total Thiol levels in various groups

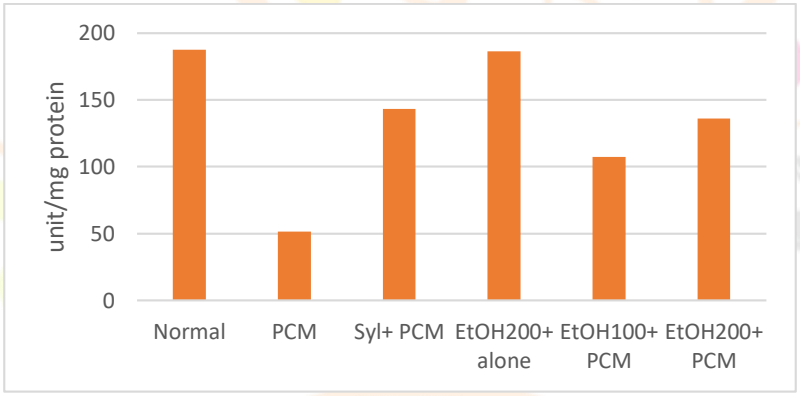

Fig.10 CAT levels in various groups

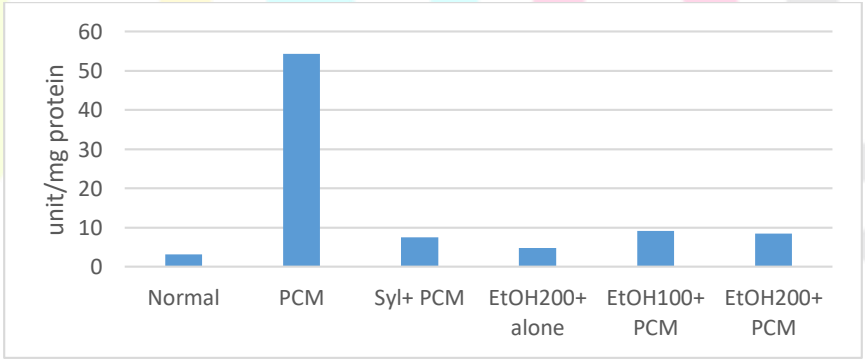

Fig.11 LPO levels in various groups

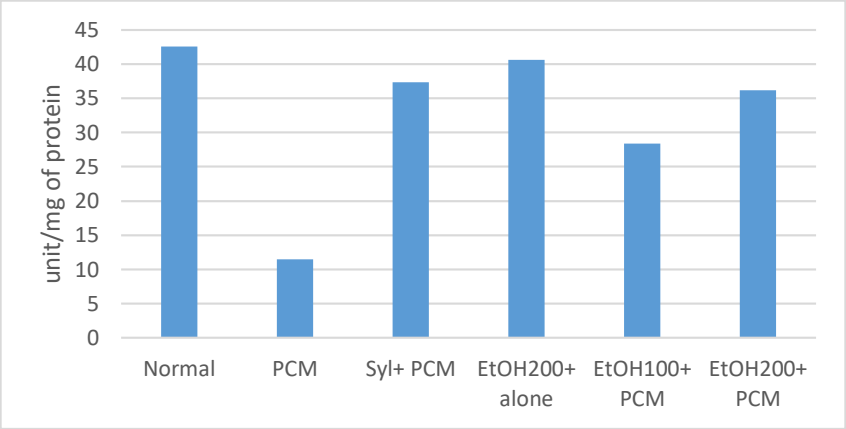

Fig.12 SOD levels in various groups

Results of *In-vitro* Antioxidant Activity (PCM):

Table:4

Effect of ethanolic extract of Cuscuta Reflexa Roxb on hydroxyl radical scavenging activity in PCM induced hepatotoxicity

concentration(µg/ml)	control	Absorbance	% inhibition in activity	IC_{50} value
6.25	0.48	0.415	13.54	
12.5	0.48	0.351	26.88	
25	0.48	0.305	36.46	
50	0.48	0.258	46.25	
75	0.48	0.222	53.75	62.8(µg/ml)
100	0.48	0.195	59.38	
200	0.48	0.145	69.79	
300	0.48	0.105	78.13	
400	0.48	0.073	84.79	

Y=8.6424x+8.8947
R^2 = 0.9922

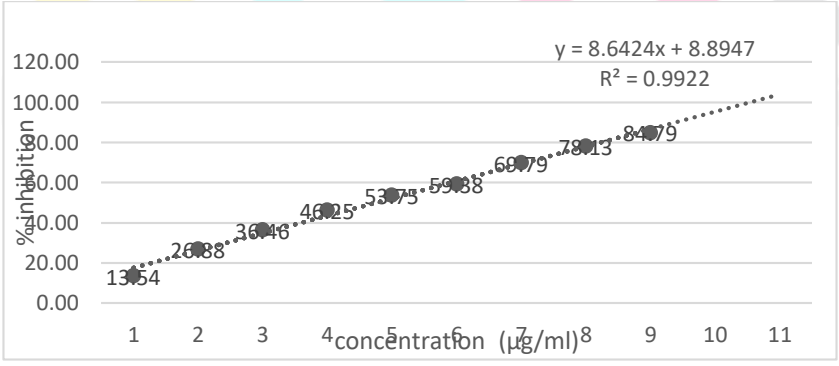

Fig.No 13**Hydroxyl radical scavenging activity**

Table 5

Effect of ethanolic extract of Cuscuta Reflexa Roxb on Lipid Peroxidation Scavenging activity in PCM induced hepatotoxicity

concentration(µg/ml)	control	Absorbance	% inhibition in activity	IC50 value
1.25	0.62	0.561	9.52	65(µg/ml)
2.5	0.62	0.547	11.77	
5	0.62	0.525	15.32	
10	0.62	0.511	17.58	
20	0.62	0.415	33.06	
40	0.62	0.342	44.84	
60	0.62	0.285	54.03	
80	0.62	0.201	67.58	
100	0.62	0.145	76.61	
200	0.62	0.102	83.55	
300	0.62	0.091	85.32	

$y = 8.827x - 7.5806$
$R^2 = 0.9696$

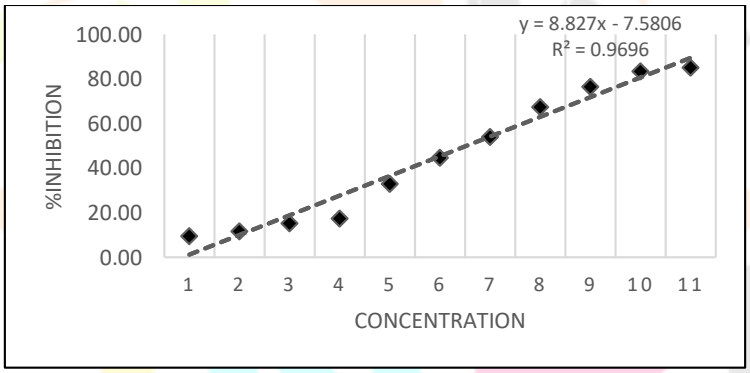

Fig.14 Lipid Peroxidation Scavenging activity

Table 6

Effect of ethanolic extract of Cuscuta Reflexa Roxb on Nitric Oxide Scavenging activity in PCM induced hepatotoxicity

concentration(µg/ml)	control	Absorbance	% inhibition in activity	IC50 value
25	0.73	0.692	5.21	362(µg/ml)
50	0.73	0.665	8.90	
100	0.73	0.632	13.42	
125	0.73	0.625	14.38	
175	0.73	0.616	15.62	

200	0.73	0.585	19.86	
250	0.73	0.515	29.45	
300	0.73	0.402	44.93	
350	0.73	0.342	53.15	
400	0.73	0.321	56.03	
450	0.73	0.315	56.85	
500	0.73	0.285	60.96	

y = 5.7146x - 5.5812
R^2 = 0.9387

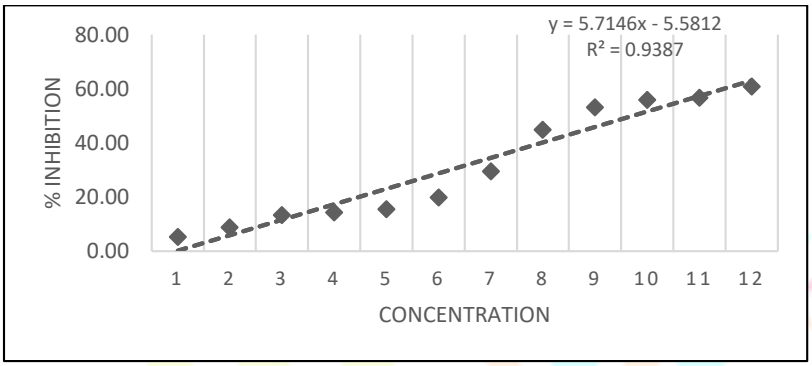

Fig.15 **Nitric Oxide Scavenging activity**

Table 7

Effect of ethanolic extract of Cuscuta Reflexa Roxb on DPPH Scavenging activity in PCM induced hepatotoxicity

concentration(µg/ml)	control	Absorbance	% inhibition in activity	IC50 value
1.25	0.62	0.591	4.68	
2.5	0.62	0.568	8.39	
5	0.62	0.532	14.19	
10	0.62	0.535	13.71	
20	0.62	0.445	28.23	
40	0.62	0.385	37.90	116(µg/ml)
60	0.62	0.365	41.13	
80	0.62	0.315	49.19	
100	0.62	0.298	51.94	
200	0.62	0.242	60.97	
300	0.62	0.222	64.19	

y = 6.4091x - 4.4076
R^2 = 0.98

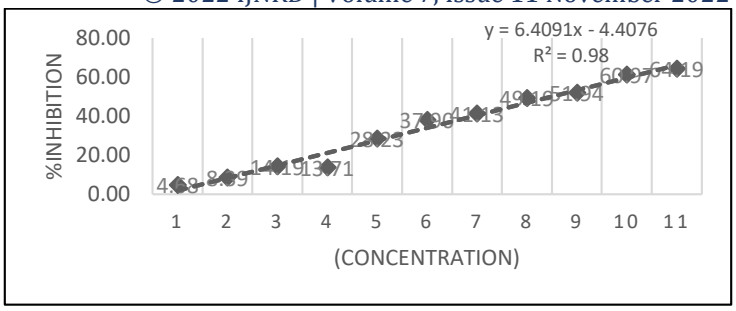

Fig. 16 **DPPH Scavenging activity**

Histopathological Studies in PCM induced hepatotoxicity:

Photograph of liver biopsy in PCM induced hepatotoxicity in mices

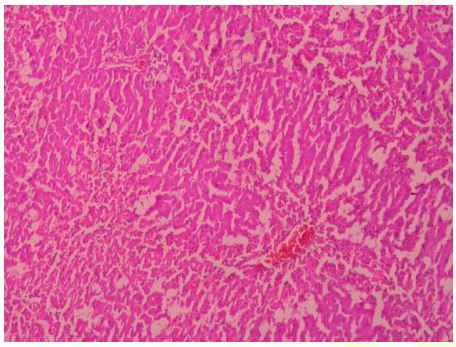

Fig:17 PCM treated group

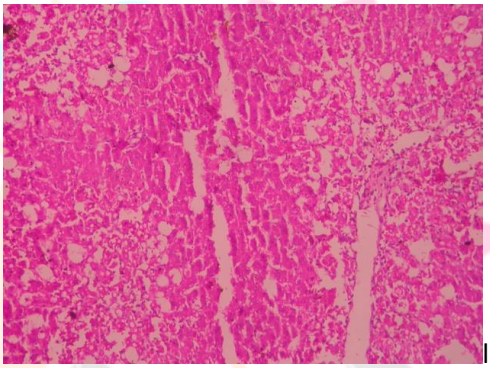

Fig:18Silymarine+PCM treated group

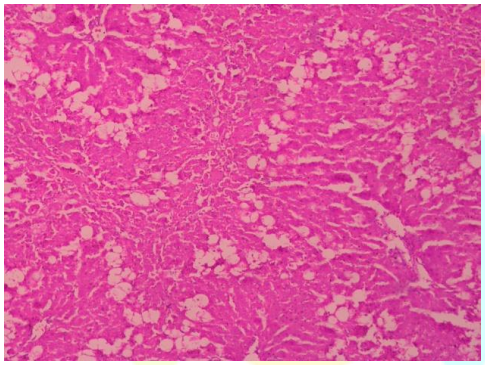

Fig:19EtoH-100+PCM treated group

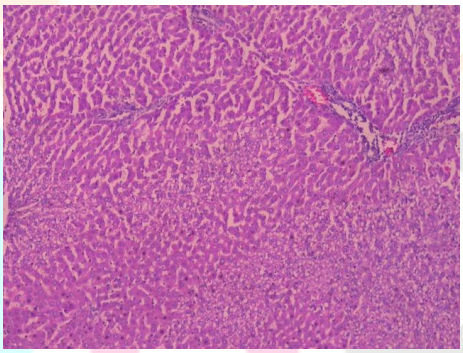

Fig:20 EtoH-200+PCM treated group

6.Discussion

In this study, we investigated how an ethanolic extract of Cuscuta Reflexa Roxb produces its effect on albino mice's livers that had been poisoned by PCM Specifically, we looked at how the extract helped to the recovery process.

The ethanolic extract that was created, put through a phytochemical test and the findings showed that alkaloids, sugars, glycosides, flavonoids and steroids were present.

According to the OECD's recommendations, research on the ethanolic extract's acute toxicity were conducted (Up and Down method). This was decided to be the upper limit because there were no fatalities at the dosage of 2000 mg/kg and dosages of 100 mg/kg and 200 mg/kg respectively were thought to be useful for evaluating hepatoprotective and antioxidant properties.

The activity of direct bilirubin (DIB), total bilirubin (TB), alanine phosphotransferase (ALP) and alanine aminotransferase (AST) & alanine transaminase(ALT) in the serum were raised in mice treated with PCM indicating liver damage and oxidative stress. The condition that develops when the liver's cell membranes are so severely damaged that they are no longer able to operate normally is known as hepatic encephalopathy. As the underlying cause of this illness, liver dysfunction can be identified[8].Following administration of the ethanolic extract, It was demonstrated that the increased levels of biochemical markers such AST, ALT, ALP and Total and Direct Bilirubin had decreased. According to the findings of the histopathological investigation, there were discernible improvements in the hepatic globular architecture, a reduction in lymphatic infiltration, and Kuffer cell proliferation that appeared normal. It would suggest from these findings that the ethanolic extract of Cuscuta Reflexa Roxb. offers some degree of protection to the liver against the toxicity caused by PCM .In light of early phytochemical studies that suggested the extract contained phenolic and flavonoid components, both of which are known for their antioxidant and hepatoprotective actions. It is important to note that these components are not present in large quantities. In order to determine the level of antioxidant activity that an ethanolic extract of Cuscuta Reflexa Roxb possessed, living organisms were used in the study. Antioxidant enzymes such as superoxide dismutase (SOD), catalase (CAT), glutathione peroxidase (GSH), lysozyme (LPO), total protein (TP), and total thiol are significant elements of this defence (TT) Which convert active oxygen molecules to non toxic. The concentrations of total protein, glutathione peroxidase,super oxidedismutase, catalase and malondialdehyde were measured to assess the level of in vivo antioxidant activity.

Therefore, either antioxidant activity or the inhibition of free radical production is substantially correlated with protection against PCM-induced hepatotoxicity.It is likely that the PCM-induced hepatotoxicity, which results in oxidative stress and ultimately liver necrosis, alters the equilibrium between ROS formation and these antioxidant defences. A decrease in the activity of the enzymes glutathione, catalase and superoxide dismutase (SOD) was utilised to show that the liver damage brought on by the treatment of PCM to mice was irreversible. In this study, those exposed to PCM had lower levels of the antioxidants glutathione (GSH), superoxide dismutase (SOD) and catalase (CAT). Following pretreatment with an ethanolic extract of Cuscuta Reflexa Roxb, the levels of glutathione (GSH), superoxide dismutase (SOD) and catalase (CAT) in the liver were all restored. Mice given PCM showed an increase in hepatic lipid peroxidation. Additionally, pretreatment with an ethanolic extract of Cuscuta Reflexa Roxb prevented the liver's MDA levels from rising, which is a symptom of accelerated lipid peroxidation[9].

Additional support for the aforementioned finding was supplied by studies of the plant extract's ability to scavenge free radicals, which were conducted independently. We discover that the ethanolic extract has substantial free radical scavenging activity against Lpx, OH and nitric oxide free radicals when we use DPPH as a measure of free radicals. This is the case when we compare the extract to these radicals.

In a similar manner, the liver weights of the animals were measured and it was discovered that the group that was treated with PCM had an increase in their liver weight. Therefore, as compared to the control groups that were given PCM, the groups who were given Cuscuta Reflexa Roxb. ethanolic extract had a significant reduction in the amount of weight of livers.Liver cytochrome P_{450} enzymes are required for the synthesis of reactive and toxic metabolites from hepatotoxicants such as carbon tetrachloride. These metabolites are subsequently accountable for inducing liver damage in experimental animals. Free radicals are known to harm cells and tissues by forming covalent connections with them and oxidising lipids among other actions. By removing "free radicals," which are lone oxygen molecules that have become out of balance, antioxidants stop oxidative damage to cells. Plasma contains several well-known enzymes that perform antioxidative functions by converting reactive oxygen and nitrogen species into stable molecules and scavenging additional free radicals including superoxide dismutase (SOD), catalase (CAT) & glutathione (GSH). These enzymes include superoxide dismutase (SOD), catalase (CAT) and glutathione (GSH). Since the biochemical and tissue abrasion caused by PCM could be reversed with treatment using an ethanolic extract of Cuscuta Reflexa Roxb, the hepatoprotective effect against PCM challenge is most likely brought on by its ability to scavenge free radicals and prevent lipid peroxidation.

7.Conclusion

This suggests that the Cuscuta Reflexa Roxb. extract's antioxidant activity may be to blame for the plant's hepatoprotective qualities. It's possible that the presence of flavonoids and phenolic chemicals shows treatment of liver damage and antioxidantactivity. Extract of Cuscuta Reflexa Roxb. has been shown to possess both hepatoprotective and antioxidant effects, as determined by biochemical and histological testing.For the purpose of screening, I used a mouse model of toxicity caused by PCM Using this model, I noticed that the ethanolic extract of Cuscuta Reflexa Roxb had the highest concentration of flavonoids and consequently the greatest hepatoprotective properties (cuscutin).

8.Reference

1. Rajesh MG, Latha MS. Preliminary evaluation of the antihepatotoxic activity of Kamilari, a polyherbal formulation. J Ethnopharmacol 2004; 91: 99–104.
2. Babu BH, Saylesh BS, Padikkala J. Antioxident and Hepatoprotective effect of Acanthus iliecifolius. Fitoterapia 2001; 72: 272-277.
3. Ciddi V, Kaleab A. Antioxidants of plant origin. Indian J Nat Pro 21(4): 3-13
4. Rao GMM, Rao, CV, Pushpangadan P, Shirwaikar A. Hepatoprotective effects of rubiadin, a major constituent of Rubia cordifolia Linn. J Ethnopharmacol 2006; 103:484–490.
5. Ghosh, M.N. (1984) In Fundamentals of Experimental Pharmacology, 2nd ed. Scientific Book Agency, Calcutta; 153-54.
6. Cristovao FL, Manuel FF & Cristina PW. Drinking of Salvia officinalis tea increases CCl4- induced hepatotoxicity in mice. Food and Chemical Toxicology 2007; 45: 456-464.
7. Hukkeri VI et al. Hepatoprotective activity of the leaves of Nyctanthes arbor-tristis Linn. Indian J Pharm Sci 2006;68(4):542-43.
8. Raja S et al. Antioxident effect of Cytisus scoparious against carbon tetrachloride treated liver injury in rats. J Ethnopharmacol 2007; 109: 41-47.
9. Sanmugapriya E & Venkataraman S. Studies of hepatoprotective and antioxidant action of Strychnos potatorum Linn. seeds on CCl4 induced acute hepatic injury in experimental rats. J Ethnopharmacol 2006; 105; 154-60.