Open Access Research Paper

ARTICLE LINK

ISSN: 2349-9818

MAY - JUNE 2022, VOL. 9 (3), 01-10

TROPICAL JOURNAL OF PHARMACEUTICAL AND LIFE SCIENCES

(An International Peer Reviewed Journal)

Journal homepage: http://informativejournals.com/journal/index.php/tjpls

PHARMACOGNOSTICAL AND PHYTOCHEMICAL EVALUATION OF BARK EXTRACT OF ZMA AND ZME *ZIZIPHUS MAURITIANA* AND ZIZIPHUS NUMMULARIA (RHAMNACEAE)

Sanwar Mal Yadav*[1], Prof. (Dr.) Vijay Kumar Sharma[2], Prof. (Dr.) Pankaj Kumar Sharma[3], Prof. (Dr.) Jaya Sharma[4], Ramesh Kumar Verma[5], Manish Dev Indoria[6]

[1,2,3,4]Department of Pharmaceutical Sciences, Apex University Jaipur, Rajasthan, India

[5]Biyani Institute of Pharmaceutical Sciences, Jaipur

[6]Department of Pharmacy, Maharishi Arvind Institute of Pharmacy, Jaipur

ABSTRACT

Medicinal plants are used in traditional system of medicine to treat various diseases and many of these plants have been evaluated for their different pharmacological activities. *Ziziphus mauritiana* (ZM) (Rhamnaceae) is found wild and cultivated in many parts of India, Burma and Srilanka. Seeds of *Ziziphus mauritiana* have been reported to have sedative-hypnotic, hypotensive, antihypoxic, antihyperlipidemic and hypothermic activities. It is reported to contain minerals, alkaloids, flavonoids, sterols, tannins and saponins. Traditional medicine using herbal drugs exists in every part of the world. The major areas are Chinese, Indian and European traditions. The philosophies of these traditional medicines have some resemblance to each other but differ widely from modern western medicine. In view of the progress of western medicine not only new synthetic drugs but also herbal drugs have to fulfill the international requirements on quality, safety and efficacy. Herbal drugs have the advantage of being available for patients in the geographical area of the special traditional medicine. The development procedure of herbal drugs for world-wide use has to be different from that of synthetic drugs.

Keywords: *Ziziphus mauritiana*, Antioxidant, Anti-inflammatory, Nephroprotective, *Ziziphus nummularia*, Rhamnaceae.

INTRODUCTION

The bark of *Ziziphus mauritiana* and *Ziziphus nummularia* used for the present studies were collected from local area of Jaipur district of Rajasthan. The plants were identified, confirmed and authenticated by comparing with voucher specimen available by taxonomist. A copy of certificate is attached. The bark was cut into small pieces and shade dried. The dried material was then pulverized separately into coarse powder by a mechanical grinder. The resulting powder was then used for extraction.

***Corresponding Author:**
Sanwar mal Yadav,
Maharishi Institute of Pharmacy,
Jaipur, Rajasthan India

MATERIAL & METHODS

Drugs: Indomethacin (Microcid from MicroLabs), Cisplatin (Kemoplat from Dabur)

Plant: The bark of *Ziziphus mauritiana* was procured and authenticated from Regional Research Institute (Ay.) (Central Council of Research in Ayurveda and Sidha, Dept of AYUSH, Ministry of Health and Family Welfare, Govt. of India, New Delhi), Government Central Pharmacy, Annexe, Ashoka Pillar, Jayanagar, Bangalore-560011.

Reagents: Benedict' sreagent, Barfoed' sreagent, Millon's reagent, Dragendroff's reagent. Hagers reagent, Mayer'sreagent. Wagner's reagent.

Chemicals: All chemicals used were of analytical grade.

Collection of plant materials

Bark of the two plants (*Z. mauritiana*Lam. and *Z. nummularia*) were collected in polythene bags from in and around local area of Jaipur-Rajasthan and air dried for two weeks in the Microbiology Laboratory. The dried leaf material was then ground into powder using blender (Monlinex 530, 240V) and packed in polythene bags for further use.

Phytochemical Screening

i. Preparation of Methanolic Extract:

The powdered drugs were dried and packed well in separate Soxhlet apparatus and extracted with 1500 ml of methanol for seven days. The extracts were concentrated and dried using Rotary flash evaporator. Both were kept in desiccators until used.

ii. Qualitative phytochemical screening:[76]

The following tests were carried out on the standardized herbal extracts to detect various phyto-constituents present in them.

iii. Detection of carbohydrates

Small quantity of the extract was dissolved in distilled water and filtered. The filterate was subjected to

1. Molisch's test
2. Fehling's test
3. Barfoed'stest

iv. Molisch'stest

To the filterate few drops of alcoholic α-napthol was added and 2ml of conc. sulphuric acid was added slowly through the slides of the test tube. No purple-colored ring was formed at junction of the two layers, which indicates absence of carbohydrates in both the extracts.

Fehling'stest

Small portion of the extract was treated with fehling's solution I and II and then heated on water bath. No brick red colored precipitate was formed, which indicates absence of carbohydrates in both theextracts.

v. Barfoed's test

Small portion of the extract was treated with barfoed's reagent. No red precipitate formed, which indicates absence of carbohydrates in both the extracts.

vi. Test of starch

A small amount of powdered drug was treated with diluted iodine solution. No blue color was observed, which indicates absence of starch in both the drugs.

vii. Detection of proteins and amino acids

Small quantity of extract was dissolved in few ml of water and was subjected to million's, biuret and ninhydrin test.

viii. Million's test:

The extract was treated with million's reagent. No white precipitate was produced, shows the absence of proteins and free amino acids in both the extracts.

ix. Biuret test:

To the extract equal volume of 5%w/v NaOH and four drops of 1%w/v $CuSO_4$ solution were added. No pink or purple color was formed indicating the absence of proteins in both the extracts.

x. Ninhydrin test:

The extract was treated with ninhydrin reagent. No purple color was produced, indicating the absence of proteins in both the extracts.

xi. Detection of phenolic compounds andtannins

The decoction was diluted with distilled

water and filtered. The filtrates were treated with following reagent.

xii. Ferric chloride test:

The filtrate was treated with 5% of ferric chloride solution. No black precipitate was found in the decoction of the plant, indicating the absence of tannins and phenolic compounds in both the filtrates.

Test with Lead acetate Solution:

Few ml of filtrate was treated with lead acetate solution. No white precipitate was produced in the decoction of both the plants.

Gelatin test:

To the filtrate of decoction, add 1ml of 1% solution of gelatin. No white precipitate was seen, which indicates absence of tannin in both the plants.

xiii. Test for phytosterols

Small quantity of decoction were dissolved in 5ml of chloroform separately.

Then these chloroform layer subjectedto,

a) Salkowskitest

b) Libermann – Burchards test

xiv. Salkowski test:

To 1ml of the above prepared chloroform solutions, few drops of conc H_2SO_4 was added. Red color produced in the lower layer, shows the presence of phytosterols in both the samples.

xv. Libermann – Burchardstest:

The above chloroform solution was treated with few drops of conc. H_2SO_4 followed by 1ml of acetic anhydride solution. Green color was produced, shows the presence of phytosterols in both the solutions.

xvi. Test for fixed oils and fats

3Spot test:

A small quantity of extracts was pressed between two filter papers, oil stain was observed in both the extracts, show presence of fixed oils in both the samples.

xvii. Saponification:

Few drops of 0.5N alcoholic potassium hydroxide was added to extracts along with a few drops of phenolphthalein. The mixture were heated on a water bath for about 1 – 2 hours. Formation of soap or a partial neutralization of alkali indicated the presence of fixed oils andfats in both the samples.

xviii. Test for alkaloids

Small amount of extracts were stirred with a few ml of dil.HCl and filtered. The filtrates were tested with various alkaloidal reagents such as Mayer's, Dragendroff's, Wagner's and Hager's reagent.

xix. Mayer's test:

To the small amount of filtrates few drops of Mayer's reagent was added. A white color precipitate was formed, indicating the presence of alkaloids in both.

xx. Dragendroff's test:

(potassium bismuthiodide)

To the small amount of filtrates few drops of Dragendroff's reagent was added. An orange red color precipitate was formed in both the samples, indicating the presence of alkaloids in both the samples.

xxi. Wagner'stest:

To the small amount of filtrate of both the drugs few drops of Wagner's reagent was added. A brown color precipitate was formed in both, indicating the presence of alkaloids in both the samples.

xxii. Hager's test: (picric acid)

To the small amount of filtrate of both drugs few drops of Hager's reagent was added. A yellow crystalline precipitate was formed in both samples, indicating the presence of alkaloids in both the samples.

Test for glycosides

Small amount of the extracts were hydrolyzed separately with hydrochloric acid for one hour on separate water baths and hydrolysates were subjected to

Legal'stest

Balget'stest

Borntrager'stest

Modified borntrager'stest.

xxiii. Legal'stest:

To the hydrolysate 1ml pyridine few drops of sodium nitroprusside solution was added and then made alkaline with NaOH solution. Pink color was obtained showing the presence of glycosides in both the samples.

Balget'stest:

To a solution of extract sodium picrate solution was added. Yellowish orange color was obtained showing, the presence of glycosides in both the samples.

xxiv. Borntrager'stest:

Hydrolysate was treated with chloroform and the chloroform layer was separated. To this equal quantity of dilute ammonia solution was added. Pink color was observed in ammoniacal layer, confirms the presence of glycosides in both the samples.

xxv. Modified borntrager'stest:

The extracts were boiled with few ml of dil. HCl and 5ml of ferric chloride solution. The contents are cooled and shaken with organic solvent. Organic layer was separated and to this equal volume of ammoniacal solution was added. The ammoniacal layer showed pink color. In this test, addition of ferric chloride was addedto break the C – C linking of glycosides which is a stronger than C = O linkage in both the samples.

Test forflavonoids

The extracts were dissolved in ethanol separately and then subjected to the following tests.

xxvi. Ferric chloridetest:

To a small quantity of Methanolic solution of extract few drops of neutral ferric chloride was added. Blackish red color was observed, showing the presence of flavonoids in both the samples.

xxvii. Shinoida'stest:

To the alcoholic solution a small piece of magnesium ribbon was added along with conc. HCl. Magenta color was formed, showing the presence of flavonoids in both the samples.

xxviii. Fluorescence test:

Alcoholic solution was seen under ultra violet light. Green color fluorescence was observed, indicating the presence of flavanoids. Reaction with alkali andacid: With sodium hydroxide solution the extracts gave yellow color. Extract gave orange color with conc H_2SO_4 indicating the presence of flavonoids in both the samples.

xxix. Zinc, HCl reduction test:

To a small quantity of extract, a pinch of zinc dust was added. Then add few drops of conc. HCl. Magenta color was produced, the presence of flavonoids in both the samples.

xxx. Lead acetatesolution:

To a small quantity of extract a few drops of 10% lead acetate solution was added. Yellow precipitate was produced, shows presence of flavonoids in both the samples.

xxxi. Detection of saponins

The extracts were diluted, with 20ml of distilled water and it was agitated in a graduated cylinder for 15 minutes. A one centimeter layer of foam was formed, indicating the presence of saponins in both the samples.

xxxii. Detection of coumarins

To a small quantity of extract were dissolved in alcohol and exposed to UV light, shows green fluorescence.

To small quantity of extract were dissolved in alcohol and add ferric chloride solution, shows green color, indicating the presence of coumarins in both the samples.

Extraction of active compounds using ethanol as solvent for extraction

Ten grams (10g) of the ground barks samples were separately soaked in 200 ml of ethanol and allowed to stand for about 72 h for extraction. After the 72 h, it was then filtered using No.1 Whatman filter paper. The filtered samples were sterilized by passing through Millipore filter and

later evaporated to dryness (Mann et al., 2008).

Preparation of test organisms

Clinical specimens of *Staphylococcus aureus, E. coli, S. pyogenes,C.albicans*and*A. niger*were obtained from Advance Labs,Mansarovar, Jaipur. The organisms were sub - cultured on agar slants prior to use. 18 h liquid culture of each of the organisms was used for sensitivity testing.

Sensitivity testing

Ethanolic extract (preparation is shown above) of each plant sample was tested against each of the organisms using agar cup well method as described by Okeke et al. (2001). After making holes with No. 4 cork borer, the surface of the agar was lawned with18 h culture of the test organism which has been previously standardized to 10^6. Same volume (0.1ml) of different concentrations of the extract (500, 50, 5 and 1 mg) was dropped with the aid of dropper pipette into each well. The plates were incubated at 37°C for 24 h and 72 h at 25ºC for bacteria and fungi respectively.

Control experiment

Standard antibiotics were used as control and the experiment procedure is as described above.

RESULT

Phytochemical constituents present in Methanolic extract of bark ofZiziphusmourtiana

Table 1.1: Details of qualitative phytochemical tests.

S.No.	Test	Pet-ether Extract	Chloroform Extract	Methanolic Extract
1	**Carbohydrates**			
	Mohlish's test	-	-	+
	Fehling's test	-	-	-
2	**Proteinsandamino acids**			
	Ninhydrin test	-	-	-
	Biuret test	-	-	-
3	**Alkaloids**			
	Mayer's test	-	+	+
	Wagner's test	-	-	+
4	**Fixed oils and fats**			
	Spot test	+	-	-
5	**Glycosides**			
	Borntrager's test	-	-	+
	Legals test	-	+	+
6	**Triterpenoids**			
	Tin + thionyl chloride	+	-	-
7	**Phenolics and tannins**			
	Ferric chloride test	-	-	-
	Gelatin test	-	-	-
	Lead acetate test	-	-	-
	Alkaline reagent test	-	-	-
	Dilute HNO3 test	-	-	-
8	**Saponins**			
	Foam test	-	+	+
	Haemolysis test	-	+	+
9	**FlavonesandFlavonoids**			
	Caddy's test	-	+	+
	Shinoda test	-	+	+

s(+) Indicates positive result (–) Indicates negative result.

In, preliminary phytochemical studies of extracts of *Ziziphus mauritiana*confirmed the strong presence of desired phytochemicals in methanolic extracts when compared to pet-ether and chloroform extracts. Hence, for the further studies Methanolic extract of *Ziziphus mauritiana*(MEAL) have beenselected.

Phytochemical constituents present in Methanolic extract of bark of Ziziphus nummularia

Table 1.2: Details of qualitative phytochemical tests.

S.No.	Test	Pet ether Extract	Chloroform Extract	Methanolic Extract
1	**Carbohydrates**			
	Mohlish's test	-	-	+
	Fehling's test	-	-	-
2	**Proteins and amino acids**			
	Ninhydrin test	-	-	-
	Biuret test	-	-	-
3	**Alkaloids**			
	Mayer's test	-	+	+
	Wagner's test	-	-	+
4	**Fixed oils and fats**			
	Spot test	+	-	-
5	**Glycosides**			
	Borntrager's test	-	-	+
	Legals test	-	+	+
6	**Triterpenoids**			
	Tin + thionyl chloride	+	-	-
7	**Phenolics and tannins**			
	Ferric chloride test	-	-	-
	Gelatin test	-	-	-
	Lead acetate test	-	-	-
	Alkaline reagent test	-	-	-
	Dilute HNO3 test	-	-	-
8	**Saponins**			
	Foam test	-	+	+
	Haemolysis test	-	+	+
9	**Flavones**			
	Caddy's test	-	+	+
	Shinoda test	-	+	+

(+) Indicates positive result (–) Indicates negative result.

In, preliminary phytochemical studies of extracts of *Ziziphus nummularia confirmed* the strong presence of desired phytochemicals in methanolic extracts when compared to pet-ether and chloroform extracts. Hence, for the further studies methanolic extract of *Ziziphus nummularia*(MEAL) have been selected.

Table 1.3: Sensitivity analysis showing zones of inhibition (mm) around crude extracts at varying concentrations.

Conc. of extracts(mg/ml)	*S.a*	*E.c*	*S.p*	*A.n*	*C.a*	*S.a*	*E.c*	*S.p*	*A.n*	*C.a*
1	**0**	**0**	**9 ± 3**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
5	**0**	**9 ± 1**	**14 ± 3**	**0**	**0**	**0**	**10 ± 4**	**13 ± 1**	**0**	**0**
50	**11 ± 2**	**12 ± 2**	**16 ± 3**	**0**	**0**	**12 ± 3**	**14 ± 0**	**18 ± 0**	**0**	**0**
500	**13 ± 1**	**16 ± 3**	**26 ± 2**	**0**	**0**	**15 ± 2**	**17 ± 1**	**28 ± 2**	**0**	**0**

Key: ***S.a = Staphylococcus aureus, E.c = Escherichia coli, S.p = Streptococcus pyogenes, A.n= Aspergillusniger,*** **C.a** ***= Candida albicans.***

Table 1.4. Zones of clearing (mm) of susceptibility testing with standard antibiotics.

Organisms	Antibiotics									
	CH	CPX	E	LC	GM	APX	RP	FLX	S	NB
E. coli	9 ± 0.1	8 ± 0.1	9 ± 0.1	0	12 ± 0.1	0	0	9 ± 0.1	8 ± 0.1	12 ±
S. pyogenes	12 ± 0.1	10 ± 0.1	9 ± 0.1	8 ± 0.1	11 ± 0.1	8 ± 0.1	8 ± 0.1	9 ± 0.1	9 ± 0.1	14 ±
S. aureus	18 ± 0.1	18 ± 0.1	16 ± 0.1	15 ± 0.1	16 ± 0.1	12 ± 0.1	14 ±	12 ±	16 ±	16 ±
A. niger	19 ± 0.1	0	0	22 ± 0.1	22 ± 0.1	18 ± 0.1	22 ±	0	16 ±	0
C. albicans	0	0	0	0	0	0	0	0	0	0

Key: CH - Chloramphenicol (10 mg), CPX - Ciprofloxacin (10 mg), E - Erythromycin (20 mg), LC - Lincocin (30 mg), GM - Gentamycin (10 mg), APX - Ampiclox (10 mg), RP - Rimbaprim (10 mg), FLX - Floxapin (30 mg), S - Streptomycin (30 mg), NB - Narbactin (10 mg).

Table 1.5 Minimum inhibitory concentration (MIC) of plant extracts against test organisms.

Plantparts	Organisms	Concentration of extract(mg/ml)							
		50	40	30	20	5	1	0	MIC
Z. mauritiana	*E. coli*	-	-	-	-	-	+	+	5
	S. aureus	-	-	+	+	+	+	+	40
	S. pyogenes	-	-	-	-	-	-	+	1
Z. nummularia	*E. coli*	-	-	-	-	+	+	+	20
	S. aureus	-	+	+	+	+	+	+	50
	S. pyogenes	-	-	-	-	-	+	+	5

Key: + = Growth, - = No growth.

Minimum inhibitory concentration (MIC)

The Minimum Inhibitory Concentration was determined using tube dilution technique. Varying concentrations of eachextract were prepared and 1 ml introduced into 9 ml of nutrient broth in test tubes. About 0.1 ml of the 18 h culture diluted to 10^6 cell ml^{-1} was added and incubated accordingly. The least concentration of the extract that did not permit turbidity in the broth was taken as the minimum inhibitory concentration.

Minimum bactericidal concentration (MBC)

Spread plate technique was employed. A fresh solid medium was inoculated with inoculum from the least concentration that showed no visible growth and incubated for 24 h at 37ºC. The lowest concentration in which no growth occurs on the solid medium was accepted as the minimum bactericidal concentration.

Table 1.3 shows that *Z. mauritiana*was active against *S. pyogenes*at 1 $mgml^{-1}$, botewere active against *E. coli* at 5 $mgml^{-1}$ but active against *S. aureus*only at 50 $mgml^{-1}$.The two fungal isolates*A. niger*and*C. albicans*were resistant.

From Table 1.4 all theorganisms were susceptible to the antibiotics except *C. albicans*which was resistant. *Z. mauritiana*showed an MIC of 1 $mgml^{-1}$ against S.*pyogenes*, 5 $mgml^{-1}$ against *E. coli* and 40 $mgml^{-1}$ against *S. aureus*while*Z. spinachristi*showed the MIC of 5 $mgml^{-1}$ against *S. pyogenes*, 20 $mgml^{-1}$ against *E. coli* and 50 $mgml^{-1}$ against *S. aureus*in

Table 1.5*Z. mauritiana*showed an MBC of 20 $mgml^{-1}$ against *S. pyogenes*, 30$mgml^{-1}$ against *E. coli* and 50 $mgml^{-1}$ against *S. aureus* while *Z.nummularia*showed the MBC of 30$mgml^{-1}$ against *S. pyogenes*, 40$mgml^{-1}$ against E. *coli* and 50$mgml^{-1}$ against *S. aureus*(Table 4).

CONCLUSION

The findings of this research work have shown clearly that the plants extracts are probably inactive against fungi and may not be useful in treating diseases of fungal origin. The extracts were active against the clinical isolates employed for this analysis. All the plants extracts were active against *S. pyogenes*an indication that the plant can be used to cure acute tonsillitis and sore throat caused by this bacterium. *Z. mauritiana*was active against *E.*

*coli, S. pyogenes*and*S. aureus*while*Z. nummularia*was very active only against *S. pyogenes*but moderately active against the rest test organisms. *Z. mauritiana*showed stronger activity against the organisms compared with *Z. nummularia.*

The standard antibiotics used as control showed higher activity on the organisms than the extracts (Tables 1.3 and 1.4). This is not surprising because standard antibiotics are well refined industrial products so there is no doubt their activity will be more compared to crude extracts. If the extracts used in the present work are refined, more and better activity could be observed. The Minimum Inhibitory Concentration of the extracts against the organisms was 1 $mgml^{-1}$against *S. pyogenes*and 5 $mgml^{-1}$ against *E. coli* while the Minimum Bactericidal Concentration was 5 and 20 $mgml^{-1}$, respectively against the organisms had similar results in their experiments involving some of these organisms. A cidal drug kills pathogens at levels only two or four times the MIC whereas a static drug kills pathogens at much higher concentrations. Some of the organic compounds detected in the extracts include tannins, saponins, resins, polyphenols and cardiac glycosides. These compounds have variously been reported to have antimicrobial activity and could be the reason for the activities recorded against these test organisms. Pants chemicals are thought to have the potentiality of useful drugs if properly harnessed.

The plants extracts were found to be inactive against the test organisms even at very high concentration which means they may not be useful against in the treatment of fungal infections such as dermatophycoses. The cell wall components of bacteria are quite different from those of fungi. While the cell wall of bacteria are either made up of acetyl muramic acid (AMA) or acetyl glucose amine (AGA) fungal cell wall is made up of fungal cellulose. This may explain the reason for the differences in their susceptibility to the plants extracts in this experiment. On the basis of these results therefore, we would like to state that constituents of these plants extracts may serve as a source of industrial drugs useful in the chemotherapy of some bacterial infections.

REFERENCES

KKokate CK, Purohit AP, Gokhale SB. Text book of Pharmacognosy. IV the Pune:NiraliPrakashan; 1996.

Vogel HG, Similarities between various systems of traditional medicine: Considerations for the future of ethnopharmacology. J. Ethnopharmacol., 1991, 35: 179-90.

Ramarao AV, Gurjar MK. Drugs from plant resources: an overview.Pharma.Times 1990; 22 (5):19-21

Handa SS. Plants as drugs. The Eastern Pharmacist 1991; XXXIV (397):79-85.

Jain SK, Ethnobotany and research on medicinal plants in India, CibaFound.Symp. 1994; 185:153-64.

Cragg GM, Boyd MR, Cardellina JH, N Newman DJ, SnaderKM,McCloud. Ethnobotany and drug discovery: the experience of the US National Cancer Institute developmental therapeutics Program, National Cancer Institute, Bethesda. Ciba Found. Symp., 1994; 185: 178-90.

Handa SS. Future trends of plants as drugs. Pharma. Times 1991; 23 (4):13-23.

Farnworth NR, A computerized data base for medicinal plants. The Eastern Pharmacist 1985; XXVIII (326):53-5.

Nearing M, The green pharmacy. Herbal medicines in modern usage. IDRC Rep., 1985; 14(1):10-1.

Mukherjee PK, Sahu M, Suresh B. Indian herbal medicines. The Eastern Pharmacist, 1998; XLI (490):21-3.

Tortora G.J, Grabowski S.R. Principles of Anatomy and Physiology. 8 thedHarper Collins College publishers inc. 1996; 824-3.

Robbins, Cotran, Kumar. Basic Pathology. 10 thed.

Liver complications.http://digestive.niddk.nih.gov/about/contact/htm.(15/8/2020)

Liver diseases.http://www.liverfoundation.org/(15/8/2020).

http://www.hepfi.org/(16/8/2020).

http://www.unos.org/(16/8/2020).

Avijeet J, Manish S, Lokesh D, Anurekha J, Rout SP, Gupta VB, Krishna KL. Antioxidant and hepatoprotective activity of ethanolic and aqueous extracts of Momordica dioica Roxb. Leaves. J Ethnopharmacol 2008; 115(1): 61-6.

Vipul Gujrati, Nilesh Patel, Venkat N Rao, K Nandakumar, TS Gouda,Md.Shalam S et al. Hepatoprotective activity of alcoholic and aqueous extracts of leaves of Tylophora indica (Linn.) in rats. Ind J. Pharmacol 2007;39 (1):43-47.

Ramachandra SS, Absar AQ, Viswanath Swamy AHM, Tushar PPT, Prabhu K, Veeran GA. Hepatoprotective activity of Calotropis procera flowers against paracetamol-induced hepatic injury in rats. Fitoterapia 2007; 8: 451–454.

Tortora GJ, Grabowski SR. The digestive system (liver and gallbladder): Principles of Anatomy and Physiology. 7th ed. New York: Harper Collins college publishers; 2002; 792-5.

www.enjoylongerhealth.com/liver-pic.html(9/8/2020)

www.arizonatransplant.com/healthtopics/liver.html(23/8/2021)

www.conatuspharma.com/liverfacts/html(10/9/2021)

Sembulingam K, PremaSembulingam. Liver and Gallbladder: Essentials of Medical Physiology. 3rd ed. New Delhi: Jaypee brother's medical publishers; 2004; 200-1.

Ghadi PS. Disorders of Liver: Pathophysiology for pharmacy. 2nd ed. Nashik: Career publications; 2000; 106-8,125-30.

Davidso. "Principle and Practice of Medicine", Churchill Livingstone Elsevier Science Ltd 1999; 19: 838-878

Gennavo AR, Remington. "The science and practice of pharmacy." Philadelphia: Lipincott Williams and Wilkins 2000;20:1088-1090.

Zimmerman HJ, Ishak KG. "Hepatotoxin injury due to drugs and toxins" London Churchill Livingstone 2002; 4: 622-24.

IshakKG.Theliver,"PathologyofDrugInduced andToxicDisease."Riddell RH, New York: Churchill Livingstone, 1982; 459.

Kirchain WR, Gill MA. "Drug – Induced Liver Disease" ,Pharmaco therapy a pathophysiological approach. London Appleton and Lange 1999;4:628-636.

Farell GC. "Drug –induced Liver Disease." Current Hepatology1991;11:95-110.

Shelly Lu, Neil Kaptowitz. "Drug–induced Hepatotoxicity." Current Hepatology 1989; 9:105-133.

Singh, R. (2019). Medicinal Plants Used In The Treatment Of Kidney, Urinary And Gallstone (Renal Stone And Herbal Treatment): A Review. International Journal of Pharmaceutical Research and Medicinal Plants, 2(1). Retrieved from http://informativejournals.com/journal/index.php/Journal_Medicinal_Plants/article/view/30

Laurance DR, Bennett PN, Brown MJ. Clinical Pharmacology. Edinburg: Churchill Livingstone 1997; 8:589-590.

Harsh Mohan. "Text book of pathology." Jaypee brothers Medical Publishers (P) Ltd, New Delhi, 2000;4:599.

Balasubramaniyan V, Kalaivani Sailaja J, Nalini N. Role of leptin on alcohol- induced oxidative stress in swiss mice Pharmacological Research 2003; 47: 211–216.

Hemieda FA, Abdel-Hady el-SK, Elnga MA. Biochemical and histological studies on H2-receptor antagonist ranitidine-induced hepatotoxicity in rats. Ind J Exp Biol 2005; 43(9):782-5.

Kumar, Cotran. Robbins. "Basic Pathology", Saunders, the Curtis center, Philadelphia Pennsylvania 2004; 7:614.

Harsh Mohan. "Textbook of Pathology", Jaypee brothers Medical Publishers Ltd 2000; 4:602-603.

Cameron GR, Thomas JC and Karunarathe WAE. The pathogenesis of liver injury in carbon tetrachloride and ethanol poisoning. J. Path. Bact 1936; 41:297.

Handa SS and Sharma A. Hepatoprotective activity of Andrographolide from *Andrographis paniculata*against carbon tetrachloride. Ind. J. Med. Res 1990; 92: 276-92.

Shirwaiker A, Sreenivasan KK, Krishnan and BR and Kumar AV. Chemical investigation and anti hepatotoxic activity of the root bark of *Caparis spinosa. Fitoterapia*1996; 67 (3): 200-4.

Rambir, Singh; BP, Nagori and Navneet, Aggarwal (2013), "Synthesis and Antimicrobial Activity of Some New Schiff's

Bases and 4- Oxothiazolidine Derivatives of 2-Mercaptobenzoxazole",Pharmacophore, Vol. 4 (1), 10-14.

Zimmerman MD and Hayman J. Function and integrity of the liver, In: Clinical diagnosis and management by laboratory methods In: Clinical diagnosis and management by laboratory methods. 17 th Ed. 1976;217-50.

Agarwal AK and Mehendale JK. Potentiation of carbon tetrachloride hepato toxicity and lethality by chlordecone in female rats. Toxicology 1983;26:231-42.

Dawkins MJR. J. Path. Bact.,1963;85:189.

Rang HR, Dale MM. "Pharmacology", Churchill Livingstone 2003; 5:391, 509, 546, 557.

Fan Sabrina, Weng Ching-Feng. Co-administration of Cyclosporine A Alleviates ethanol induced liver injury. World J Gastroenterol2005;11(10):1411-1419.

Shapiro Haim, Ashkenazi Michal, Weizman Nir, Shahmurov Mark Hussein Aeed, Bruck Rafael. Curcumin ameliorates acute ethanol induced hepatotoxicity. J of Gastroenterol &Hepato 2006; 21:358-366.

Singh Rambir and Nagori B.P. (2017), "Design, synthesis, characterization and evaluation of benzoxazole derivatives for their antihyperglycaemic activitye", Pharmacophore, 8(1), 43-53.

Hemieda Faried AE, Abdel Hady El-Sayed. Biochemical and histological studies on H2-receptor antagonist ranitidine-induced hepatotoxicity in rats. Ind J Exp Bio2005;43:782-785.

Rambir Singh, Bodhisattwa Maiti, BP Nagori (2011), "Recent trends in herbal drugs: a review", International Journal of Drug Research and Technology, Volume 1,Issue,1,Pages 17-25.

M Raza, M Ahmad, A Gado, OA Al-Shabanah. A comparison of hepatoprotective activities of amino guanidine and N-acetyl cysteine in rat against the toxic damage induced by azathioprine. Comparative BiochemPhysiol 2003; 134: 451–456.

Kapur V, Pillai KK, Hussain SZ and Balani DK. Hepatoprotective activity of Jigrine on liver damage caused by alcohol-carbon tetrachloride and paracetamol in rats. Ind. J. Pharmacol1994;26:35-40.

Saraswat B, Visen PKS, Dayal R, Agarwal DP and Patnaik GK. Protective action of ursolic acid against chemical induced hepatotoxicity in rats, Ind. J. Pharmacol. 1996; 28: 232-39.

Padma W, Suja V, Shyamala DCS and Prema. Hepatoprotective effect of Liv-52 on antitubercular drug-induced hepatotoxicity in rats. Fitoterapia 1998; 69(6): 520-22.

Harshmohan. The liver, biliary tract and exocrine pancreas. In: Text book of pathology, 4 th Ed, Jaypee Brothers Medical Publishers (P) Ltd. New Delhi. 2002; 22-4 ,569-630.

Kind PRN and King EJ. Estimation of Plasma Phosphates by Determination of Hydrolysed Phenol with Antipyrine. J. Clin. Pathol.1954;322-30.

Klaassen CD and Plaa GL. Effect of CCl_4 on the Metabolism, Storage and Excretion of Sulfobromophthalein. Toxicol. Appl. Pharmacol 1968; 12:132-9.

Avadhoot Y and Rana AC. Hepatoprotective effect of Vitexnegundo against carbon tetrachloride induced liver damage. Arch. Pharm. Res. 1991; 14(1):96-8.

How to cite this article: Sanwar Mal Yadav, Prof. (Dr.) Vijay Kumar Sharma, Prof. (Dr.) Pankaj Kumar Sharma, and Manish Dev Indoria. "PHARMACOGNOSTICAL AND PHYTOCHEMICAL EVALUATION OF BARK EXTRACT OF ZMA AND ZME ZIZIPHUS MAURITIANA AND ZIZIPHUS NUMMULARIA (RHAMNACEAE)". Tropical Journal of Pharmaceutical and Life Sciences, vol. 9, no. 3, June 2022, pp. 01-15, https://informativejournals.com/journal/index.php/tjpls/article/view/86.

PUBLISHED BY:
INFORMATIVE JOURNALS
JADOUN SCIENCE PUBLISHING GROUP INDIA