Pharmacogn J. 2018; 10(4): 705-711
A Multifaceted Journal in the field of Natural Products and Pharmacognosy
www.phcogj.com | www.journalonweb.com/pj | www.phcog.net

Original Article

Pharmacological Studies of *Oxalis pes-caprae* L.

Syeda Naila*, Muhammad Ibrar

ABSTRACT

Background: *Oxalis pes-caprae* is also called as "sourgrass" or soursob. The roots, stems and leaves of *Oxalis pes-caprae* have high medicinal values and have the function of anti-inflammatory and analgesia, clearing heat, removing toxicity. In present study *Oxalis pes-caprae* belonging to family oxalidaceae evaluated for pharmacological activities like cytotoxicity, phtotoxicity, antibacterial and antifungal bioassays. **Materials and Methods:** Cytotoxic activity was performed by brine shrimp bioassay using methodology of Atta-ur-Rahman *et al.*, 2001. The phytotoxic activity was investigated by applying *Lamna minor* (as test species) following Atta-ur-Rahman *et al.*, 2001.Anti-bacterial screening was conducted following Rathan (2000). Anti-fungal screening was carried out using agar well diffusion method following Perez *et al.* (1990) and Atta-ur-Rahman *et al.* (1991). **Results:** Its ethanolic extract showed highly significant (100%) cytotoxicity with LD_{50} 8.98 at 1000 ppm. *Lemna minor* phytotoxicity assay showed that *O. pes-caprae* chloroform extract showed 90% inhibition at 1000 ppm with FI_{50} 0.1048. Antibacterial bioassays showed that all the samples of the plant were significant against *Xanthomonas, Clavibacter machengnitis* and *Bacillus* at 1000, 1500 and 2500 ppm doses. Dose dependent antifungal activities against test species (*Aspergillus flavus, Penicillium* and *Fusarium solani*) were noticed for all the extracts at 100 and 1000 ppm. **Conclusion:** Pharmacological potentials showed that this plant can be used in upcoming time for extracting numerous active constituents for their pharmacological preparations.

Key words: Pharmacology, *Oxalis pes-caprae,* Whole plant, Cytotoxic activity, Phytotoxic activity, Antifungal activity, Antibacterial activity.

Syeda Naila*, Muhammad Ibrar

Department of Botany, University of Peshawar, Peshawar, Khyber Pakhtunkhwa, PAKISTAN.

Correspondence

Syeda Naila

Department of Botany, University of Peshawar, Peshawar, Khyber Pakhtunkhwa, PAKISTAN.

Phone no : +923369163696

E-mail: syedanaila13@gmail.com

History

- Submission Date: 25-01-2018;
- Review completed: 06-03-2018;
- Accepted Date: 03-05-2018

DOI : 10.5530/pj.2018.4.117

Article Available online

http://www.phcogj.com/v10/i4

INTRODUCTION

Biochemical, chemical, physical and biological characteristics of drug and exploration of novel drugs from natural sourcesare studied in field of pharmacognosy.[1] The subjects of Botany, Chemistry and Pharmacology are involved in the study of medications from plant sources.[2] Pharmacognostical research consists of phytochemistry, microbiology, biosynthesis, biotransformations, chemotaxonomy and other biological and chemical sciences.[3] Measure of the strength or potency of the functional constituents or indicator compound is known as standardization. It's used to mention the batch-to-batch consistency of effective ingredients instead of the intensity and reliability of the pharmacological effects and within the industry and several regulatory agencies has been the matter of extreme discussion.[4]

Pharmacognosist Professors Jerry L. McLaughlin and colleagues established simple brine shrimp lethality ``bench top" bioassay,[5] that proved suif to regulate the diagnosing of anti-tumours and cytotoxics compound from plant.[6] Phytotoxic activity is the initial weedicide bioactivity of natural products for screening potential phytotoxic plants.[7]A variety of novel antimicrobial drugs in the recent period have been developed by pharmaceutical industries but at the same time opposition to these drugs by microbes has built up. Generally, bacteria exhibit the genetic capability to transfer and develop resistance to drugs used as healing agents.[8] Use of synthetic fungicides for control of fungal infestations is common, but its use is constrained because of the noxious effects on organism's healthiness and on surroundings.[9]

Oxalis pes-caprae L.is perennial, herbaceous plant withbulbiferous andunderground stem.It is native to South Africa. It is naturalized to West Europe and Mediterranean region, South West Asia, North Africa, Turkey and Iran. In the plains having shady places, it is found as a weed.[10] The plant is edible and in moderate quantity is unhazardous. This plant also a traditional constituent in recipe i.e. water blommet jiebredie (water flowers stew) in South Africa.[11] In several traditions it is used in folk medicines, as foods and for oxalic acid. For treating tapeworm and may be other worms, raw bulbs are used. It is also utilized as diuretic. Fleshy underground runners are also eaten with milk.[12] Yellow dye is obtained from the golden petals.[13] The roots, stems and leaves of *Oxalis pes-caprae* have high medicinal values and

Cite this article: Naila S, Ibrar M. Pharmacological Studies of *Oxalis Pes-caprae* L. Pharmacog J. 2018;10(4):705-11.

have the function of anti-inflammatory and analgesia, clearing heat, removing toxicity.[14]

MATERIALS AND METHODS

Plant Collection and Preservation

Fresh collection of *Oxalis pes-caprae* at their flowering stagewas carried out from Department of Botany, University of Peshawar, Pakistan. Plant materials were cleaned, washed and garbled. Few fresh plants of *Oxalis pes-caprae* were pressed, dried, pasted on herbarium sheet and assigned voucher numbers (Bot. 20128 (PUP) and deposit in herbarium (Department of Botany, University ofPeshawar, Pakistan) for reference. Collection was dried in shade at about 25±3 ^{0}C and powdered with electric grinder. For protecting powder frommolds, insects attack andmoisture, these were stored inair tight bottles and used for various biochemicals and biological research studies.

Extract Preparation

In airtightbottles, 500ml of different solvents (ethanol, methanol, n-hexane, acetone, chloroform) and 100gm powder of plants were mixed and kept for 7 days with occasional shaking. After this extract was filtered and in rotary evaporators filtrates were dried.

Pharmacology

For measuring therapeuticpotential of *Oxalis pes-caprae* the following pharmacological studies were conducted.

Cytotoxic Bioassay

Cytotoxic activity was performed for ethanolic, methanolic, acetone, n-hexane and chloroform extractsof *Oxalis pes-caprae by*brine shrimp bioassay using methodology of.[15]

Requirements

Artemia salina (shrimps eggs), sea salt solution (38g/L of distilledwater), illuminating source (lamp) to attractbrine-shrimp larvae, hatching tray with perforated partition, Pasture's pipettes, magnifying lens, micro pipettes (5, 50,500µl), test samples, test tube stands, test tubes, ethanol, methanol, acetone, n- hexane and chloroform.

Technique for Hatching

Filtered brinesolution was put inhatching tray (rectangular dish (22x32 cm). 2 unequalpartitions (perforated) were made in tray. 25mg brine shrimp eggs powder was scattered in smaller portion. The larger portion was remaining uncover and smaller was wrap with black paper. For hatching of eggs, tray was kept at room temperature. For illuminating open portion of tray, lamp was hanging over tray. The hatched napualli were viewed to move toward theenlightened portion.

Preparation of Sample

Sample was prepared by dissolving 20mg of extract in 2ml of solvent. To test tubes (3 test tubes /concentration) 5, 50 and 500 µl solution was transferred i.e. equivalent to10, 100 and 1000 µg/ml respectively. Solvents could evaporate overnight and to each test tube 5ml seawater solution (38 g/L) was added and transferred 10 larvae with help of Pasteur pipettes. At room temperature (25-27°C), test tubes were kept under illumination. Test tubes filled with brine solution and reference cytotoxic drug used for negative and positive controls respectively.

Statistical Tests

Numbers of dead and live napualli were counted after 24 hr. The data was analyzed through Biostat software to determine LD_{50} values.[16]

Phytotoxic Bioassay

The phytotoxic activity of ethanolic, methanolic, acetone, n-Hexane and chloroform extracts of *Oxalis pes-caprae* was investigated by applying *Lamna minor* (as test species) following.[15]

Require Materials

Distilled water, micropipettes (10-100 µl, 100-1000 µl), flask 250ml, test samples (extracts), *Lemna minor* (test species), filter paper, oven, petri dishes, luminarflow hood, glass vials, E- medium, brush.

Media Preparation

For *Lemna minor* bioassay, E-medium was made from various mineral nutrients having known quantity (Table 1). First the salts were weighed in required quantity then dissolved in distill water and volume was made up to 1000ml. By addition of KOH, pH was adjustedbetween 5.5-6.00.

Methodology

Sample was prepared by dissolving 15mg of extract in 1.5ml of solvent and to sterilized petri dish (3 petri dishesfor each concentration) 5, 50 and 500µl solutions were transferred i.e. equivalent to 10, 100 and 1000µg/ml respectively. Solvents could evaporate overnight in sterilized condition in laminar flow. To each petri dish 20ml E.medium was added. Petri dishes filled with E. medium alone and standard drug (Atrazine) used as negative and positive controls respectively. 10 plants of *Lemna minor* with two fronds were transferred to each petri dish. Numbers of frondswere counted on 3rd and 7th day of experiment. With reference to negative control, percent growth inhibition was noted by applying formula

$$\% \text{ Inhibition} = 100 - \frac{\text{Number of fronds in test sample}}{\text{Number of fronds in negative control}} \times 100$$

Statistical Tests

Results for phytotoxicity were analyzed by using Biostat software to determine FI_{50} values.[16]

Antibacterial Activity

Anti-bacterial screening was conducted for ethanolic, methanolic, acetone, n- Hexane and chloroform extracts of*Oxalis pes-caprae* following.[17]

Requirments

Nutrient broth, test samples, nutrient agar, Laminar flow unit, Standard antibiotics (streptomycin), micropipettes, sterile cotton swab, petri dishes, test tubes, incubator, autoclave, filter paper discs, DMSO.

Test Organisms

Xanthomonas, Clavibacter machengnitis and *Bacillus.*

Procedure

Antibacterial activities of the plants were conducted by filter paper disc method as explained by.[17] On nutrient broth, bacterial strains were cultured and before experiments incubated for 24 hr. Nutrient agar was melted, cooled to 40^{0}C and transfer into sterilized petridishes. By using sterilized cotton swab, 4 to 8 hr old bacterial culture was spread on surface of nutrient agar. Betweeneach streaking, turning the plate 60^0 repeating the procedure thrice. Filter paper discs were placed in petridishes and to these discs sample extracts, four concentrations i.e. 100ppm, 1000ppm, 1500ppm and 2500ppm were applied. Other discs were filled with DMSO and 100ppm streptomycin used as negative and

positive controls respectively. For 24 hr the plates were incubated at 37^{0}C and then noted for zones of inhibition.

Antifungal Activity

Anti-fungal screening of ethanolic, methanolic, acetone, n- Hexane and chloroform extract of *Oxalis pes-caprae* were carried out using agar well diffusion method following.[18,7]

MATERIAL

Seven days old fungal cultures, test samples, potato dextrose agar (PDA), Dimethyle sulphoxide (DMSO), petri dishes, cork borer, micropepites, autoclave, incubator, Laminar flow Unit (LFU), spirit, standard antibiotic (streptomycin), fungicide.

Test Fungi

Aspergillus flavus, Penicillium and*Fusarium solani.*

METHODOLOGY

25 ml pre-sterilized PDA was poured in each pre-sterilized petridishes under sterile conditions and allowed to solidify. Wells of 6mm diameter was made by sterile cork borer in media. To the wells, sample extract of two concentrations i.e. 100ppm and 1000ppm was added through micro-pipette. Next each petri dish was inoculated with 6 mm diameter piece of inoculumcut off from seven days old fungal culture. Media filled with DMSO and fungicide was used for negative and positive controls respectively. Petri dishes were incubated at 27^{0}C for7 days. During incubation cultures were examined twice weekly. Growth in media was calculated by measuring growth (mm) of fungal strains loaded with DMSO, fungicide and sample. Percentage inhibition of fungal growth was calculated by following formula.[19,20]

$$\% \text{ Mycelia inhibition} = \frac{Gn - Gt}{Gn} \times 100$$

Where, Gn = Mycelial growth in normal
Gt = Myclial growth in test

RESULTS

Pharmacology

Following pharmacological activities were performed on extracts of *O. pes-caprae.*

Cytotoxic Bioassay

In the current work Brine shrimp's lethality bioassay was conducted for knowing the cytotoxicity of ethanolic, methanolic, acetone, n-hexane and chloroform extractof *O. pes-caprae.* Three concentrations (10ppm, 100ppm, and 1000ppm) were applied against brine shrimps. The extracts were found to produce dose dependent cytotoxicities, based on the following criteria

30-40% lethality – Low activity

50% lethality – moderate activity

60-70% lethality –good activity

Above 70% lethality – significant activity

The highest significant cytotoxicity was shown by ethanolic extract which caused 100% (LD_{50} 8.98) cytoxicity at 1000ppm followed by chloroform extract (93.33%), n-hexane (90%), methanol and acetone (86.66%). OPE also showed significant effect at 100ppm i.e. 73.33%. While at 10ppm and 100ppm all extracts depicted low to good activity. The result was shown in Table 2 and Figure 1.

Phytotoxic Bioassay

In the present work, the phytotoxic potential of crude ethanolic, methanolic, acetone, n-hexane and chloroform extract of *O. pes-caprae* was evaluated by using *Lemna minor*. Three phytotoxic doses were used. The extract showed low to moderate level inhibitions of frond proliferation, w. r. t following criteria (given below) used for phytotoxic potential

30-40% inhibition: Low activity

50% inhibition: moderate inhibition

60-70% inhibition: good activity

Above 70% inhibition – significant activity

The effect of extract was dose dependent. The data was taken on fourth day and seventh day of experiment. On fourth day the significant effect was shown by chloroform extract at 1000ppm (76%, FI_{50} 0.073). All other

Table 1: E-medium's composition.

Name of chemicals	g/L
Potassium dihydrogen phosphate (KH2PO4)	0.68
Potassium nitrate(KNO3)	1.515
Calcium nitrate (Ca(NO2)2.4H2O)	1.180
Magnesium sulfate (MgSO4.7H2O)	0.492
Boric acid (H3BO3)	0.00286
Manganous chloride (MnCl2.4H2O)	0.00362
Ferric chloride (FeCl2.4H2O)	0.00540
Zinc sulfate (ZnSO4.5H2O)	0.00022
Copper sulfate (CuSO4.5H2O)	0.00022
Sodium molybdate (Na2MO4.2H2O)	0.00012
Ethylene diamino tetra acetic acid (EDTA)	0.01120

Table 2: Brine shrimp's lethality cytotoxic bioassay of ethanolic (OPE), methanolic (OPM), acetone (OPA), n-hexane (OPH) and chloroform (OPC) extracts of *Oxalis pes-caprae* showing % mortalities and LD_{50}.

Treatment	No. of shrimps	Percent mortality			LD_{50}
		10ppm	100ppm	1000ppm	
Control (-)	30	-	-	-	
OPE	30	56.66±5.77	73.33±5.77	100±0.00	8.98
OPM	30	33.33±5.77	53.33±5.77	86.66±5.77	48.14
OPA	30	26.66±5.77	36.66±5.77	86.66±5.77	96.58
OPH	30	30.00±0.00	40±10.00	90±0.00	30.96
OPC	30	46.66±5.77	53.33±5.77	93.33±5.77	21.25

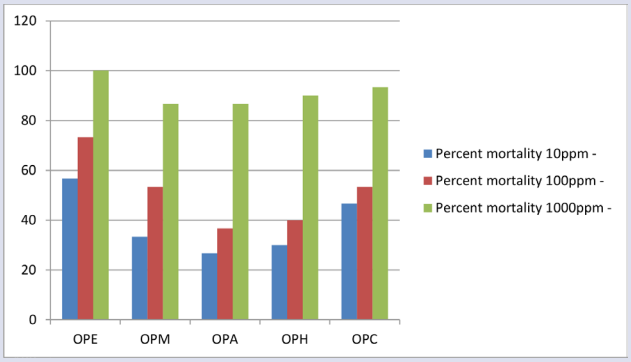

Figure 1: Brine shrimps lethality cytotoxic bioassay of ethanolic, methanolic, acetone, n-hexane and chloroform extracts of *Oxalis pes-caprae.*

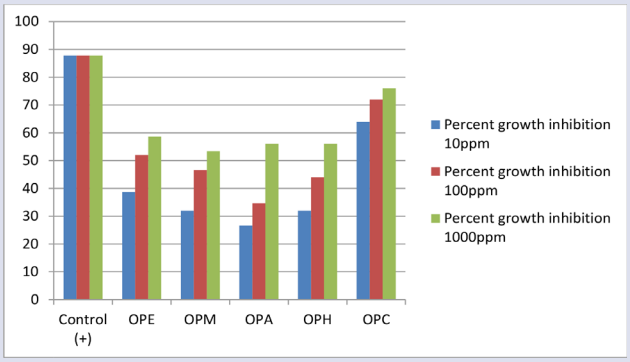

Figure 2: Lemna phtotoxicity of ethanolic, methanolic, acetone, n-hexane and chloroform extract of *Oxalis pes-caprae* showing % inhibition after 3 days of experiment.

Table 3: Lemna phtotoxicity of ethanolic (OPE), methanolic (OPM), acetone (OPA), n-hexane (OPH) and chloroform (OPC) extract of *Oxalis pes-caprae* showing % inhibition and FI_{50} after 3 days of experiment.

Treatment	Percent growth inhibition			FI_{50}
	10ppm	100ppm	1000ppm	
Control (+)	87.82±1.11	87.82±1.11	87.82±1.11	0.0395
OPE	38.66±2.30	52±4	58.66±2.30	421.9592
OPM	32±4	46.66±6.11	53.33±2.30	367.3615
OPA	26.66±4.61	34.66±2.30	56±4	551.9551
OPH	32±4	44±4	56±4	319.1081
OPC	64±4	72±4	76±4	0.073

Table 4: Lemna phtotoxicity of ethanolic (OPE), methanolic (OPM), acetone (OPA), n-hexane (OPH) and chloroform (OPC) extract of *Oxalis pes-caprae* showing % inhibition and FI_{50} after 6 days of experiment.

Treatment	Percent growth inhibition			FI_{50}
	10 ppm	100 ppm	1000 ppm	
Control (+)	87.82±1.11	87.82±1.11	87.82±1.11	0.0395
OPE	62.66±2.30	69.33±2.30	84±4	1.4229
OPM	49.33±6.11	60±4	86.66±2.30	15.6293
OPA	42.66±15.14	52±4	69.33±2.30	44.0706
OPH	56±4	68±4	68±4	0.557
OPC	85.33±4.61	90±6.11	88±4	0.073

extracts showed low to good activity at 10ppm and 100ppm. On seventh day of experiment the significant inhibition was shown by chloroform extract at 100ppm which was 90% with FI_{50} 0.073. The entire extracts showed moderate to significant activity at 10 and 1000ppm. The results are summarized in Table 3 and 4, Figure 2 and 3.

Antibacterial Activity

For curing bacterial infections, anti-microbial activity gives chief basis. In current study ethanolic, methanolic, acetone, n-hexane and chloroform extract of *O. pes-caprae* against *Xanthomonas, Clavibacter machengnitis* and *Bacillus* at 100, 1000, 1500 and 2500ppm were tested. All the extracts showed significant inhibition zone at 2500ppm against all bacterial strains. The highest inhibition was showed by ethanolic extract at

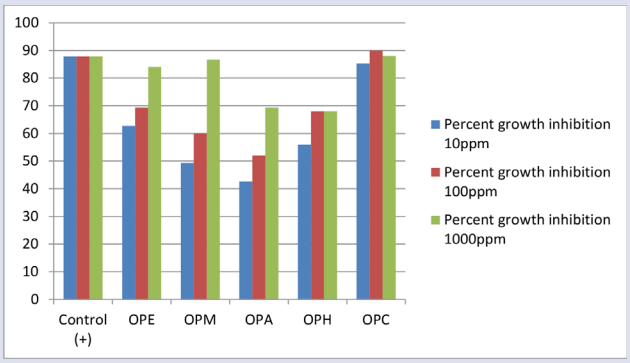

Figure 3: Lemna phtotoxicity of ethanolic, methanolic, acetone, n-hexane and chloroform extract of *Oxalis pes-caprae* showing % inhibition after 6 days of experiment.

2500ppm against *Xanthomonas, Clavibacter* and *Bacillus* which were 16.25±0.353, 17.75±0.35 and 20.5±0.70 respectively. At 100ppm the extracts showed low inhibition zone against strains which were 10, 9.75±0.35, 11, respectively (Table 5, Figure 4).

Antifungal Activity

In the current work ethanolic, methanolic, acetone, n-hexane and chloroform extracts of *O. pes-caprae* were examined for antifungal potential against fungalstrains like*Aspergillus flavus, Penicillium* and *Fusarium solani* at 100 and 1000ppm. The results are presented in Table 6 and Figure 5. Ageneral trend of dose dependency was observed i.e. effect became more pronounced withincreasing concentration of the various tested samples. Ethanolic extract was found effective against*A. flavus* (48.24±1.24%) followed by *Fusarium solani* (41.5±0.70 %) and *Penicilliun* (35.34±0.98 %) at 1000ppm.

DISCUSSION

Cytotoxic Bioassay

Many researchers conducted the activity on different plants like Ali *et al.*[21] (2009) analyzed root extracts of *Euphorbia wallichii* for cytotoxicity. Nisar *et al.*[22] (2011) reported crude methanolic extract and various fractions from *Zizyphus oxyphylla* stem. Khuda *et al.*[23] (2012) investigated the extracts from leaves of *X. strumarium, Achyranthes aspera, Valeriana*

Table 5: Antibacterial activities of ethanolic, methanolic, acetone, n-hexane and chloroform extracs of *Oxalis pes-caprae* at different concentrations. All values are mean ± SEM of 3 determination.

Treatment	Concentration	Zone of inhibition (mm)		
		Xanthomonas	*Clavibacter machengnitis*	*Bacillus*
DMSO (-)		-	-	-
Streptomycin (+)	100 ppm	17.5±0.70	18.75±0.35	21.75±0.35
OPE	100 ppm	10±0.00	9.75±0.35	11±0.00
	1000 ppm	12.25±0.35	12.25±0.35	13.75±0.35
	1500 ppm	13.25±0.35	13.75±0.35	15.25±0.35
	2500 ppm	16.25±0.35	17.75±0.35	20.5±0.70
OPM	100 ppm	11±0.00	9.5±0.00	10.75±1.06
	1000 ppm	11.5±0.00	12.75±0.35	14.5±0.00
	1500 ppm	13.25±0.35	13.75±0.35	14.75±0.35
	2500 ppm	16±0.00	17.75±0.35	20.5±0.70
OPA	100 ppm	9.75±0.35	9.0±0.00	9.25±0.35
	1000 ppm	12.25±0.35	12±0.00	13.25±0.35
	1500 ppm	13±0.00	13.25±0.35	14.25±0.35
	2500 ppm	16.25±0.35	16.75±1.06	19.25±0.35
OPH	100 ppm	9.25±0.35	9.5±0.00	9±0.00
	1000 ppm	12.5±0.00	12.25±0.35	12.25±0.35
	1500 ppm	12.75±0.35	1.25±0.35	14.5±0.70
	2500 ppm	15.25±0.35	15.25±0.35	17.75±0.35
OPC	100 ppm	9.75±0.35	9.75±0.35	9±0.00
	1000 ppm	11.25±0.35	11.5±0.70	11.25±0.35
	1500 ppm	13±0.00	13.75±1.06	14.25±0.35
	2500 ppm	14.25±0.35	15.5±0.70	16.5±0.70

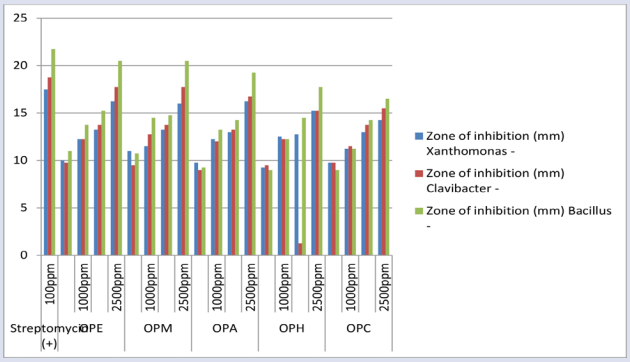

Figure 4: Antibacterial activities of ethanolic, methanolic, acetone, n-hexane and chloroform extracts of *Oxalis pes-caprae* at different concentrations.

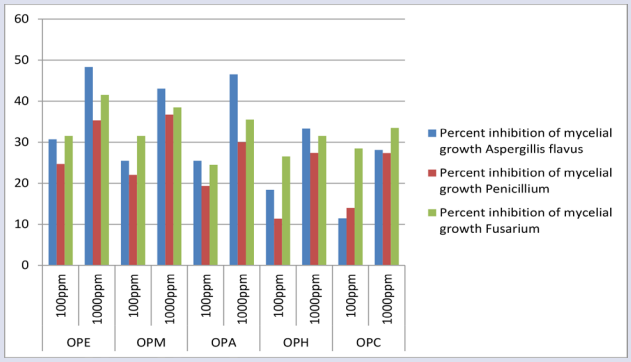

Figure 5: Antifungal activities of ethanolic, methanolic, acetone, n-hexane and chloroform extracts of *Oxalis pes-caprae* at different concentrations.

wallichii and roots of *Duchesnea indica* for cytotoxic activity.Our study is in line with these workers.

Phytotoxic Bioassay

Hameed *et al.*[24] (2013) evaluated methanolic and acetone extracts of the *Withaniasomnifera, Datura innoxia*, *Solanum surattense*, *Withania coagulans and Solanum nigrum*for phytotoxicity. Shah *et al.*[25] (2013) demonstrated crude methanolic extract and solvent fractions of *Conyza bonariensis*for the phytotoxicity. Rehmanullah *et al.*[26] (2014) performed phytotoxic activity on *Euphorbia helioscopa* and *Euphorbia hirta*. These all workers have carried out similar studies which strengthen the present findings.

Antibacterial Activity

Various other workers have also conducted such studies on various plants, e.g., Hafeez *et al.*[27] (2014) reported antibacterial activity of

Table 6: Antifungal activities of the ethanolic, methanolic, acetone, n-hexane and chloroform extracs of *Oxalis pes-caprae* at different concentrations. All values are mean ± SEM of 3 determination.

Treatment	Concentration	Percent inhibition of mycelial growth		
		Aspergillis flavus	*Penicillium*	*Fusarium solani*
OPE	100 ppm	30.69±1.23	24.66±0.94	31.5±0.70
	1000 ppm	48.24±1.24	35.3±0.98	41.5±0.70
OPM	100 ppm	25.43±1.23	21.99±0.94	31.5±0.70
	1000 ppm	42.97±1.23	36.66±0.94	38.5±0.70
OPA	100 ppm	25.43±1.23	19.33±0.94	24.5±0.70
	1000 ppm	46.48±1.23	29.99±0.94	35.5±0.70
OPH	100 ppm	18.41±1.23	11.33±0.94	26.5±0.70
	1000 ppm	33.32±2.48	27.33±0.94	31.5±0.70
OPC	100 ppm	11.4±1.24	13.99±0.94	28.5±0.70
	1000 ppm	28.06±2.48	27.3±0.98	33.5±0.70

Eruca sativa, Bombax malabaricum, Chorisia speciosa,Bauhinia variegate, Kigelia Africana, Nigella sativa, Pinus halepensis, Zingiber officinale, Piper nigrum, Albizzia lebbeck, Ceiba pentandra, Origanum majorana, Rosmarinus officinalis, Ocimum basilicum, Thymus vulgaris, Mentha piperita, Simmondsia chinensis, Linum usitatissimum, Pimpinella anisum and *Brachychiton opulneus.* All extracts exhibited significant effect. He concluded that best aqueous extract was from *A. lebbeck.* Madureira *et al.*[28] (2014) determined the antimicrobial potential of *Sanguisorba hybrid.* All extracts were tested againstyeast *Candida albicans*, Gram-negative (*Salmonella typhimurium*, *Klebsiella pneumonia, Pseudomonas aeruginosa,*) Gram-positive (*Staphylococcus aureus, Staphylococcus epidermidis, Mycobacterium smegmatis, Enteroccocus faecalis*). Our study is in line with these workers.

Antifungal Activity

Similar antifungal investigations were performed by several workers on various plants. Khan *et al.*[29] (2011) worked out antifungal activity of *Adhatoda vasica*, *Viburnum cotinifolium*, *Vitex negundo*, *Peganum harmala*,*Mimosa rubicaulis, Broussonetia papyrifera*, *Chenopodium ambrosoides, Euphorbia hirta, Taraxacum officinale*, *Urtica dioica*, *Verbascum Thapsus*, *Caryopteris grata* and *Woodfordia fruiticosa*, Nisar *et al.*[22] (2011) performed antifungal activity on crude methanolic extract and different fractions from *Zizyphus oxyphylla* stem against 5 fungal strainsviz., *Aspergilus flavus, Fusarium solani, Microsporum canis, Candidaglaberata*and *Candida albicans.* Shah *et al.*[25] (2013) analyzed*Conyza bonariensis*for antifungal activity. Our study is in line with these workers.

CONCLUSION AND RECOMMENDATION

In *O. pes-caprae* highest significant cytotoxicity was shown by ethanolic extract at 1000ppm with LD_{50} 8.98 which revealed this plant contains a good cytotoxic compound. The highest significant phytotoxicity was shown by chloroform extract at 1000ppm with FI_{50} 0.1048 which depicted that this plant contains a natural weedicide character. The highest antibacterial activity was shown by ethanolic extract against *Xanthomonas, Clavibacter machengnitis*and *Bacillus* which was 16.25±0.353, 17.75±0.35, 20.5±0.70. The highest antifungal activity was shown by ethanolic extract against *A. flavus* (48.24±1.24%) followed by *Fusarium solani* (41.5±0.70 %) and *Penicillium* (35.34±0.98 %) at 1000ppm. It can be concluded that this plant is a natural antibacterial and antifungal. Pharmacological potentials like cytotoxic, phytotoxic, antibacterial and antifungal activities of plants showed that these plants can be used in upcoming time for extracting numerous active constituents for their pharmacological preparations. These results might be exploited as cheaper effectual remedies for different ailments.

CONFLICT OF INTEREST

The authors declare no conflict of interest.

SUMMARY

In present study *Oxalis pes-caprae* belonging to family oxalidaceae evaluated for pharmacological activities like cytotoxicity, phtotoxicity, antibacterial and antifungal bioassays. Its ethanolic extract showed highly significant (100%) cytotoxicity with LD_{50} 8.98 at 1000 ppm. *Lemna minor* phytotoxicity asssay showed that *O. pes-caprae* chloroform extract showed 90% inhibition at 1000 ppm with FI_{50} 0.1048. Antibacterial bioassays showed that all the samples of the plant were significant against *Xanthomonas, Clavibacter machengnitis* and *Bacillus* at 1000, 1500 and 2500 ppm doses. Dose dependent antifungal activities against test species (*Aspergillus flavus, Penicillium* and *Fusarium solani*) were noticed for all the extracts at 100 and 1000 ppm. Pharmacological potentials showed that this plant can be used in upcoming time for extracting numerous active constituents for their pharmacological preparations.

ABBREVIATIONS

OPE: *Oxalis pes-caprae* ethanol; **OPM:** *Oxalis pes-caprae* methanol; **OPA:** *Oxalis pes-capra e*acetone; **OPH:** *Oxalis pes-caprae* n-hexane; **OPC:** *Oxalis pes-caprae* chloroform.

REFERENCES

1. Balunas MJ, Kinghorn AD. Drug discovery from medicinal plants. Life Sci. 2005;78(5):431-41.
2. Blondeau QTD, Scior T, Bernard P, Morin-Allory L. Reverse pharmacognosy: another way to harness the generosity of nature. Curr Pharm Des. 2010;16(15):1682-96.
3. Rezuan SB. Macro and micro morphological characterization of Jackia ornate. University Teknologi Mari (UiTM). 2010.
4. Awang D. Feverfew products. Can Med Assoc J. 1997;157(5):510-20.
5. Meyer BN, Ferrigni NR, Putnam JE, Jacobsen LB, Nichols DE, McLaughlin JL. Brine shrimp: aconvenient general bioassay for active plant constituents. Planta Med. 1982;45(5):31-4.
6. Andereson JE, Goetz CM, McLaughlin JE, Suffness M. Ablind comparison of simple bench-top bioassaysand human cell cytotoxicities as antitumor prescreens. Phytochem. Anal. 199;2(3):107-11.
7. Atta-ur-Rehman. Studies in Natural Product Chemistry, Netherlands. Elsevier Science Publishers. 1991;9:383-09.
8. Nascimento GF, Locatelli J, Freitas PC, Silva GL. Antibacterial activity of plant extracts and phytochemicals on antibiotic-resistant bacteria. Braz J Microbiol.

2000;31(4):247-56.
9. Harris CA, Renfrew MJ, Woolridge MW. Assessing the risk of pesticide residues to consumers: recent and future developments. Food Addit Contam. 2001;18(12):1124-9.
10. Nasir Y. Flora of Pakistan. Department of Botany, University of Karachi: Karachi. 1971;4:1-3.
11. Villiers SJA. Cook and Enjoy. NB Publishers. 2010.
12. Mitchell WJ, Wijk BB, Gerdina M. The medicinal and poisonous plants of Southern and Eastern Africa. 2nd ed Pub. E and S Livingstone. 1962.
13. Tortorello M. "A New Generation Discovers Grow-It-Yourself Dyes". The New York Time. 2012.
14. Zhongyao LI, Yingzi HE, Xuejing QI. Research progress of biological activities of oxalis. Medicinal Plant. 2014;5(10):1-3,6.
15. Atta-ur-Rehman, Choudhary MI, Thomsen WJ. Bioassay Technique for Drug Development Harwood Academic Publishers. 2001.
16. Barkatullah, Ibrar M, Muhammad N. Evaluation of Zanthoxylum armatumDC for in-vitro and in-vivo pharmacological screening. Afr J Pharm and Pharmacol. 2011;5(14):1718-23.
17. Rathan A. Antimicrobials in laboratory medicine. BI Churchill Livingstone Pvt Ltd, New Delhi. 2000;194-03.
18. Perez C, Paul M, Bezique P. Alta biomed. Group Experiences. 1990;105-13.
19. Umadevi S, Mohanta GP, Chelladurai V, Manna PK, Manavalan R. Antibacterial and antifungal activity of Andrographis echiodes. J Nat Remedies. 2003;3(2):185-8.
20. Ali-Shtayeh MS, Suheil AG. Antifungal activity of plants extracts against dermatophytes. Mycoses.1999;42(11-12):665-72.
21. Ali I, Naz R, Khan WN, Gul R, Choudary MI. Biological screening of different root extracts of Euphorbia wallichii. Pak J Bot. 2009;41(4):1737-41.
22. Nisar M, Kaleem WA, Qayum M, Marwat IK,Zia-Ul-Haq M, Ali I, et al. Biological screening of Zizyphus oxyphylla Edgew stem. Pak J Bot. 2011;43(1):311-7.
23. Khuda F, Iqbal Z, Zakiullah, Khan A, Nasir F, Muhammad N,et al,. Metal analysis, phytotoxic, insecticidal and cytotoxic activities of selected medicinal plants of Khyber Pakhtunkhwa. Pak J Pharm Sci. 2012;25(1):51-8.
24. Hameed I, Hussain F, Sher Z, Bacha N, Khan AA. Cytotoxicity and phytotoxicity of some medicinal plants of family solanaceae. Pak J Bot. 2013;45(5):1749-54.
25. Shah NZ, Muhammad N, Azeem S, Khan AZ, Muhammad S, Khan H. Antimicrobial and phytotoxic properties of Conyza bonariensis. Pharm Res. 2013;1(1):8-11.
26. Rehmanullah, Din S, Shah S, Muhammad Z. Pharmacological evaluation of Euphorbia helioscopia L. and Euphorbia hirta. Int J Biosci. 2014;4(1):20-6.
27. Hafeez EYA, Nguyen TN, Karamova NS, Ilinskaya ON. Antibacteial activity of certain medicinal plants on different bacterial strains associated with colorectral cancer. Int J Biosci. 2014;5(7):219-29.
28. Madureira AM, Duarte A, Correia AI, Teixeira G.Sanguisorba hybrida: pharmacognostic studies and antimicrobial activity. Revista de Ciencias Agrarias. 2014;37(4):482-90.
29. Khan AM, Qureshi RA, Gillani SA, Ullah F. Antimicrobial activity of selected medicinal plants of Margalla Hills, Islamabad, Pakistan. J Med Plants Res. 2011;5(18):4665-70.

Cite this article: Naila S, Ibrar M. Pharmacological Studies of *Oxalis Pes-caprae* L. Pharmacog J. 2018;10(4):705-11.