



AMERICAN JOURNAL OF PHARMTECH RESEARCH

Journal home page: <http://www.ajptr.com/>

Phytochemical and antiulcer potential of ethanolic leaf extract of *houltuynia cordata*, thumb.

Mrinmoy Basak^{1*}, Biplab Kr. Dey¹

1. Department of Pharmacy, Assam down town University, Pnikhaiti, Guwahati, Assam, Pin-781026

ABSTRACT

Gastric ulcer is one of the most prevalent gastrointestinal disorders, which affects approximately 5-10% of people during their life. In recent years, abundant work has been carried out on herbal medicine to clarify their potential efficacy in gastric ulcer prevention or management. Here, present study was carried out to investigate antiulcer activity of ethanol extract of *Houttuynia cordata* Thumb. (Family: Saururaceae) leaves in aspirin plus pylorus ligated ulceration in the albino rats. Preliminary ethanol extract of *H. cordata* was subjected to the phytochemical study. Two dose levels i.e. 250 and 500 mg/kg were selected for the further study. In Aspirin plus pylorus ligation induced ulcer model, various parameters were studied viz. gastric volume, pH, total acidity, free acidity, and ulcer index. Ranitidine at 50 mg/kg was used as the standard drug. Pretreatment of ethanol extract of *H. cordata* leaves showed significant ($P < 0.001$) decrease in the gastric volume, total acidity and free acidity. However, pH of the gastric juice was significantly ($P < 0.01$) increased only at higher dose, 500 mg/kg. It showed also significant ($P < 0.001$) decrease in number of ulcers and ulcer score index in aspirin plus pylorus ligation induced ulceration models. The ethanol extract of *H. cordata* leaves possess significant antiulcer properties in a dose dependent manner. In conclusion the antiulcer properties of the extract may be attributed to the presence of phytochemicals like flavonoids (quercetin), alkaloids and tannins present in the plant extract with various biological activities.

Keywords: Antiulcer activity, Aspirin plus Pylorus ligation, Ulcer index, Phytochemical screening, *Houttuynia cordata*.Thumb,

*Corresponding Author Email: mrinmoybsk@gmail.com

Received 14 September 2016, Accepted 03 October 2016

Please cite this article as: Basak M *et al.*, Phytochemical and antiulcer potential of ethanolic leaf extract of *houltuynia cordata*, thumb . American Journal of PharmTech Research 2016.

INTRODUCTION

Peptic ulcer disease is one of the most common gastrointestinal disorders, which causes a high rate of morbidity particularly in the population of non-industrialized countries.¹ Peptic ulcer occurs due to an imbalance between the aggressive (acid, pepsin and *Helicobacter pylori*) and the defensive (gastric mucus and bicarbonate secretion, prostaglandins, innate resistance of the mucosal cells) factors.² In Ayurveda, peptic ulcer mostly refers to *Amlapitta* or *Parinamasula*. *Amlapitta* is a disease of the gastrointestinal tract, especially of the stomach. *Amlapitta* literally means, pitta leading to sour taste.³ Number of drugs including proton pump inhibitors, prostaglandins analogs, histamine receptor antagonists and cytoprotective agents are available for the treatment of peptic ulcer. But most of these drugs produce several adverse reactions including toxicities and even may alter biochemical mechanisms of the body upon chronic usage.⁴ Hence, herbal medicines are generally used in such cases when drugs are to be used for chronic periods. Several natural drugs have been reported to possess anti-ulcerogenic activity by virtue of their predominant effect on mucosal defensive factors.⁵⁻⁶

Houttuynia cordata (Saururaceae) (HC) has a long history of use in the Chinese indigenous system of medicine. As a traditional Chinese medicine, HC is used to relieve lung conditions such as lung abscess, phlegm, cough and dyspnoea.⁷ It has been reported that HC is effective in treating pneumonia, infectious disease, refractory haemoptysis and malignant pleural effusion.⁸ Biologically, HC may exert antimicrobial, immunostimulatory, diuretic, anticancer, sedative, anti-inflammatory, anti-allergic and antitussive effects.⁹⁻¹² It was found that HC has antiviral activities against herpes simplex virus type 1, influenza virus and human immunodeficiency virus.¹³⁻¹⁴ More recent evidence indicates that HC is a safe and efficient agent having anti-severe acute respiratory syndrome-associated coronavirus activities.¹⁵ The whole plant is antibacterial, anti-inflammatory, antimicrobial, antiphlogistic, antiviral, depurative, diuretic, emmenagogue, febrifuge, hypoglycemic, laxative and ophthalmic. A decoction is used internally in the treatment of many ailments including cancer, coughs, dysentery, enteritis and fever. Its use is said to strengthen the immune system. Externally, it is used in the treatment of snake bites and skin disorders. The leaves and stems are harvested during the growing season and used fresh in decoctions. The leaf juice is antidote and astringent. A root extract is diuretic. The root is also said to be used in medicinal preparations for certain diseases of women. An active substance, effective in the treatment of stomach ulcers, has been extracted from the plant.¹⁶⁻²²

In the current study, antiulcer effect of HC ethanolic extract in aspirin plus pylorus ligated rats were investigated

MATERIALS AND METHOD

Collection & authentication of plant material of the Plant: The entire plant of *Houttuynia cordata* Thumb. was collected from Nalbari district of Assam during the month of March-April. They were thoroughly washed in running water, segregated from the grass and other extraneous material and the field data of the plant like its height, flower colour and soil condition were noted in the note book. The authentication was carried out by the help of Dr. A.A. Mao (Scientist-E & H.O.O), Botanical Survey of India (BSI), Eastern Regional Centre, Shillong- 793003 No: BSI/ERC/2015/Plant identification/148.

Preparation of extracts by hot extraction: 500 g of the dried pulverized whole plant of *Houttuynia cordata* Thumb. were taken in soxhlet apparatus .After initial defatting with ethanol, hot extraction in a soxhlet apparatus at a temperature not exceeding 70⁰ C were carried out. Then the extract obtained had been filtered and treated at reduced temperature on a rotary vacuum evaporator and concentrated stored at 4⁰ C until further use. The yield was found to be around 7.00% (w/w) with respect to dried whole plant of *Houttuynia cordata* Thumb. Dried extract was kept in desiccator and used for further study.

Experimental animals:

Healthy young Albino rats weighing between 120 g to 200 g were procured. The animals were individually housed in polypropylene cage and the room condition was maintained at temperature of 25±5 deg C and humidity 45±5 per cent with 12 hr day and night cycle. The animals were fed with Pellet chew feed standard diet and water *ad libitum*. All experimental procedures were conducted with the approval of the Institutional Animal Ethics committee CPCSEA (Reg. No- AdtU/IAEC/2015/006) for the care and use of animals and their guidelines were strictly followed throughout the study.

Preliminary phytochemical test:

The ethanolic extract obtained from the extraction process was then subjected to various qualitative tests reported methods to determine the presence of various phytoconstituents such as alkaloids, glycosides, saponin, flavonoids, carbohydrates, amino acids, sterols, gums and mucilage etc.

The concentrated extracts were subjected to chemical test as per the methods mentioned below for the identification of the various constituents²³⁻²⁴

Detection of alkaloid:

Solvent free extract, 50mg is stirred with few ml of dilute hydrochloric acid & filtered. The filtrate is tested carefully with various alkaloidal reagents as follows:

- **MAYER'S TEST:** To a few ml of filtrate, a drop or two of Mayer's reagent are added by the side of the test tube. A white or creamy ppt indicates test as positive.
- **WAGNER'S TEST:** To a few ml of filtrate, few drops of Wagner's reagent are added by the side of the test tube. A reddish-brown ppt. indicates test as positive.
- **HAGER'S TEST:** To a few ml of filtrate, 1 or 2 ml of Hager's reagent are added by the side of the test tube. A prominent yellow ppt. indicates test as positive.
- **DRAGENDORFF'S TEST:** To a few ml of filtrate, 1 or 2ml of Dragendorff's reagent are added by the side of the test tube. A prominent yellow ppt. indicates test as positive.
- **Detection of carbohydrates:**
- The extract (100mg) is dissolved in 5ml of water & filtered. The filtrate is subjected to the following test.
- **MOLISH'S TEST:** To 2 ml of filtrate, 2 drops of alcoholic sol of alpha-naphthol are added, the mixture is shaken well & 1ml of cone. H_2SO_4 is added slowly along the side of the test tube & allowed to stand. A violet ring indicates the presence of carbohydrate.
- **FELING'S TEST:** 1 ml filtrate + 1 ml each of Fehling's solutions A&B heat on water bath for 2 minute and presence of red ppt. indicate the present of sugar.
- **BENEDICT'S TEST:** To 0.5ml of filtrate, 1ml of benedict reagent is added and the mixture heated on a boiling water bath for 2 minute a characteristic colour ppt indicates the present of sugar.
- **BARFOED'S:** To 1 ml of filtrate, 1ml of barfoed reagent is added and the mixture heated on a water bath for 2 minutes and red ppt. indicates the present of sugar.

Detection of saponin:

The extract 50 mg is diluted with water and made up to 20ml. The saponin is shaken for 15 minutes and a layer of 2 cm of foam indicates the presence of saponin.

Detection of phenolic compounds:

- **FERRIC CHLORIDE TEST:** The extract 50 mg is dissolved in 5 ml of distilled water to this few drops of 5% ferric chloride solution is added. A dark green colour indicates the presence of phenolic compound.

- **GELATIN TEST:** The extract 50 mg is dissolved in 5 ml of distilled water and 2 ml of 10% sodium chloride solution is added. White ppt. indicates the presence of phenolic compounds.

Detection of glycosides and flavanoids:

50mg of extract is hydrolysed with concentrate hydrochloric acid for 2 hr on a water bath, filtered and hydrolysate is subjected to the following test:

- **BORNTRAGER'S TEST:** To 2ml of filtered hydrolysate, 3ml of chloroform is added and shaken, chloroform layer is separated and 10% ammonia solution is added to it and pink color indicates the presence of glycoside.
- **LEAD ACETATE TEST:** The extract 50mg is dissolved in distilled water and to this 3ml of 10% lead acetate solution is added. A bulky white ppt. indicates the present of flavanoid.
- **MAGNESIUM AND HYDROCHLORIC ACID REDUCTION:** The extract 50mg is dissolved in 5ml of alcohol and few fragment of magnesium ribbon and HCL acid drop wised is added. If any pink to crimson color develops presents of flavanols glycoside is confirm.
- **ALKALINE REAGENT TEST:** An aqueous solution of the extract is treated with 10 % of Ammonium hydroxide solution. Yellow fluorescence indicates the present of flavanoid.
- **AQUEOUS SODIUM HYDROXIDE TEST:** An aqueous solution of the extracts is treated with sodium hydroxide solution it give blue to violet (Anthrocyanine), yellow (flavones) and yellow to orange (flavonones).
- **CONCETRATED SULPHURIC ACID TEST:** An aqueous solution of the extracts is treated with conc. Sulphuric acid it gives yellowish orange (Anthrocyanines), yellow to orange (flavones), orange to crimson (flavanones).

Detection of proteins and amino acids:

- **MILLONS TEST:** 2 ml of filtrate + few drops of Millon's reagent and white ppt. indicates the present of proteins and amino acids.
- **BIURETS TEST:** An aliquot of filtrate is treated with conc. Drug of 2% copper sulphate solution. To this 1ml of ethanol of 99% is added followed by excess of potassium hydroxide pellet. Pink color in the ethanolic layer indicates the presents of protein.
- **NINHYDRIN TEST:** Two drops of ninhydrin solution (10mg of ninhydrin in 200ml of acetone) is added to 2ml of aqueous filtrate. A characteristic colour indicates the presence of proteins.

- **LEGAL TEST:** 50mg of extracts is dissolved in pyridine, a sodium nitroprusside solution is added and makes alkaline using 10% of NAOH and presence of protein is indicated by pink colour.
- **KILLER KILLIANI TEST:** To an extract of drug in GAA, few drops of ferric chloride and conc. sulphuric acid were added. A reddish brown colour is form at the junction of two layer and upper layer turns bluish green.

Detection of phytosterols:

LIBBERMANN-BURCHARDS TEST: Extracts 50mg and 2ml acetic anhydride. To this soln. 1-2 drops of conc. Sulphuric acid is added along the side of test tube. And array of color changes shows the presence of phytosterols.

Detection of fixed oils and fats:

- **SPOT TEST:** Pressed a small quantity of extract separately between two filter paper. Oil stains on the paper indicates the presence of fixed oil.
- **SAPONIFICATION TEST:** Add a few drops of 0.5N alc. KOH to a small quantity of extracts along with a drop of phenolphthalein. Heat the mixture on water bath for 1-2 hour. Formation of soap or partial neutralization of alkali indicates the presence of fixed oil and fats.

Detection of gums and mucilage:

Extract 100mg is dissolved in 10ml of distilled water and to this 25ml of absolute alc. is added with constant stirring. White or cloudy precipitation indicates the presence of gums and mucilage.

Detection of coumarin:

Extract 50mg is dissolved in 10ml absolute alc. and to this few drops of ferric chloride is added. Greenish fluorescence indicates the presence of coumarin.

Aspirin plus pylorus ligation-induced ulcer:

Ethanollic leaf extract, aspirin and ranitidine were prepared in 0.5% carboxymethyl cellulose (CMC) as suspension and administered orally once daily at a volume of 10 ml/kg for 7 days using an oral gavage needle. The rats were divided into five groups ($n=6$). Group I was administered with 0.5% CMC, which served as normal control. Group II received only aspirin (200 mg/kg) and served as ulcer control group, group III and IV were treated with leaf extracts (250 and 500 mg/kg, respectively). Group V received ranitidine (50 mg/kg) and served as standard.

From day 5 to day 7, rats in group III-V received aspirin at a dose of 200 mg/kg, 2 hr after the administration of the respective drug treatment. Rats in all the groups were anaesthetized with

ether on day 8 after 18 hr of fasting. The abdomen was cut opened by a small midline incision below the xiphoid process and pylorus portion of the stomach was lifted out and ligated avoiding traction to the pylorus or damage to its blood supply. At the end of 4 hr after ligation, the rats were scarified with excess of anesthetic ether and the stomach was dissected out.²⁵⁻²⁶

Measurement of gastric acid secretion, pH and ulcer index:^{25,26}

The stomach of each animal was carefully excised keeping esophagus closed; the gastric contents were collected and centrifuged at 1000Xg for 10 min. the volume of supernatant was measured and expressed as ml/100 g. The pH of the supernatant was measured using digital pH meter. Stomach was opened along the greater curvature and microscopic observation of the lesions in glandular portion was examined by two investigators. Ulcer index (UI) was calculated by using the arbitrary scoring system as follows:-

- Loss of normal morphology - 1
- Discolouration of mucosa - 1
- Mucosal oedema - 1
- Haemorrhages - 1
- Petechial point (until 9) - 2
- Petechial point (>10) - 3
- Ulcer upto 1 mm - nX2
- Ulcer >1 mm - nX3
- Perforated ulcer - nX4

Where, 'n' is the number of ulcer found.

Percentage inhibition of ulceration was calculated as below:

$$\% \text{ Inhibition of Ulceration} = \frac{\text{Ulcer index Control} - \text{Ulcer index Test}}{\text{Ulcer index Control}} \times 100$$

Determination of total acidity²⁶

An aliquot of 1ml gastric juice diluted with 1ml of distilled water was taken into a 50 ml conical flask and two drops of phenolphthalein indicator was added to it and titrated with 0.01N NaOH until a permanent pink colour was observed. The volume of 0.01N NaOH consumed was noted.

The total acidity is expressed as mEq/L by the following formula:

$$\text{Acidity} = \frac{\text{Vol. of NaOH} \times \text{N} \times 100 \text{ mEq/L}}{0.1}$$

Determination of free acidity²⁶

Instead of phenolphthalein indicator, the Topfer's reagent was used. Aliquot of gastric juice was titrated with 0.01N NaOH until canary yellow colour was observed. The volume of 0.01N NaOH consumed was noted. The free acidity was calculated by the same formula for the determination of total acidity.

RESULTS AND DISCUSSION

The ethanolic extract of *Houttuynia cordata*, Thumb was found to contain carbohydrates, glycosides, flavonoids, alkaloids, phytosterol and phenolic compounds and absent of saponin, protein and amino acid (Table-1).

Nonsteroidal analgesic antiinflammatory drugs like aspirin can effects on oxidant and antioxidant mechanisms and interfere prostaglandin synthesis through cyclooxygenase pathways, produce neutrophil and oxygen radical dependent microvascular injury leading to mucosal damage. Aspirin acts directly by increasing the H⁺ ion transport while on the mucosal epithelial cells, it decreases mucin, surface-active phospholipids, bicarbonate secretion and microvasculature damage by generation of free radicals.²⁵ In pylorus-ligated rats the gastric acid secretion is an important factor for generation of ulceration. When aspirin was administered to pylorus-ligated rats it further aggravated the acidity and the resistance of the gastric mucosa was decreased thereby imposing extensive damage to the glandular region of the stomach. Aspirin plus pylorus ligation-induced animals models was used to investigate the antiulcerogenic activity of ethanolic extract of *Houttuynia cordata*, Thumb and ulcer control group show significant differences in ulcer parameters when compared to healthy control group.

Aspirin plus pylorus ligation-induced animals showed extensive gastric lesions that were confined to the glandular portion of the stomach, which is evidenced by an increase in ulcer index (UI) when compared to untreated control. Pre-treatment with test drug (250 and 500 mg/kg) produced 32.70 and 45.94% inhibition of UI, respectively (fig. 1). Treatment with test drug caused a decrease in gastric juice volume, total acidity and free acidity. Both the dose produced almost similar effect to that of standard dug. Total and free acidity also decreases significantly (p<0.001) compare to ulcer control group. Gastric pH was significantly improved in the ulcer control group after treatment with *Houttuynia cordata* extract and ranitidine (Table-2). These effects may contribute to the cytoprotective effect of *Houttuynia cordata* extract.

Table 1: Phytochemical Analysis of Leaf of *Houttuynia cordata*, Thumb

Test	Ethanollic extract
Alkaloids	+
Carbohydrates	+
Glycosides	+
Phytosterols	+
Fixed oil and fats	-
Phenolic compound and Tannins	+
Saponins	-
Proteins and Amino acids	-
Gums and Mucilage	-
Flavonoids	+

(+) - Present

(-) - Absent

Table 2: Effect of *Houttuynia cordata*, Thumb extract on gastric parameters in aspirin plus pylorus ligation-induced ulcer rats

Group	Dose	Volume of gastric juice (ml/100 gm)	pH	Total acidity (mEq/1/100 gm)	Free acidity (mEq/1/100 gm)
Healthy Control	0.5% CMC	1.00 ± 0.06	2.00 ± 0.06	61.36 ± 0.26	36.86 ± 1.20
Ulcer Control(Aspirin)	200 mg/kg	4.90 ± 0.09	1.20 ± 0.26	78.16 ± 0.16	50.56 ± 1.12
<i>Houttuynia cordata</i> ethanolic extract	250 mg/kg	3.80 ± 0.06***	1.80 ± 0.06	65.06 ± 0.11***	47.35 ± 1.35
<i>Houttuynia cordata</i> ethanolic extract	500 mg/kg	3.00 ± 0.08***	2.30 ± 0.22**	63.06 ± 0.23***	38.90 ± 1.75***
Ranitidine	50 mg/kg	2.50 ± 0.07***	2.56 ± 0.12***	58.18 ± 0.22***	36.70 ± 1.35***

Values are expressed as (Mean ± S.E.M.), n= 6, **p<0.01 and ***p< 0.001 when compared with control group. (Statistically analyzed by one-way analysis of variance (ANOVA) followed by Tukey test.)

Table-3 Effect of ethanolic extract of *Houttuynia cordata*, Thumb on gastric ulcer induced by aspirin plus pylorus ligation in rats

Group	Dose	Ulcer Index	% Ulcer Inhibition
Healthy Control	0.5% CMC	-----	----
Ulcer Control(Aspirin)	200 mg/kg	3.70 ± 0.56	----
<i>Houttuynia cordata</i> ethanolic extract	250 mg/kg	2.49 ± 0.54**	32.70
<i>Houttuynia cordata</i> ethanolic extract	500 mg/kg	2.00 ± 0.38***	45.94
Ranitidine	50 mg/kg	1.80 ± 0.76***	51.35

Values are expressed as (Mean ± S.E.M.), n= 6, **p< 0.01 and ***p< 0.001 when compared with control group. (Statistically analyzed by one-way analysis of variance (ANOVA) followed by Tukey test.)

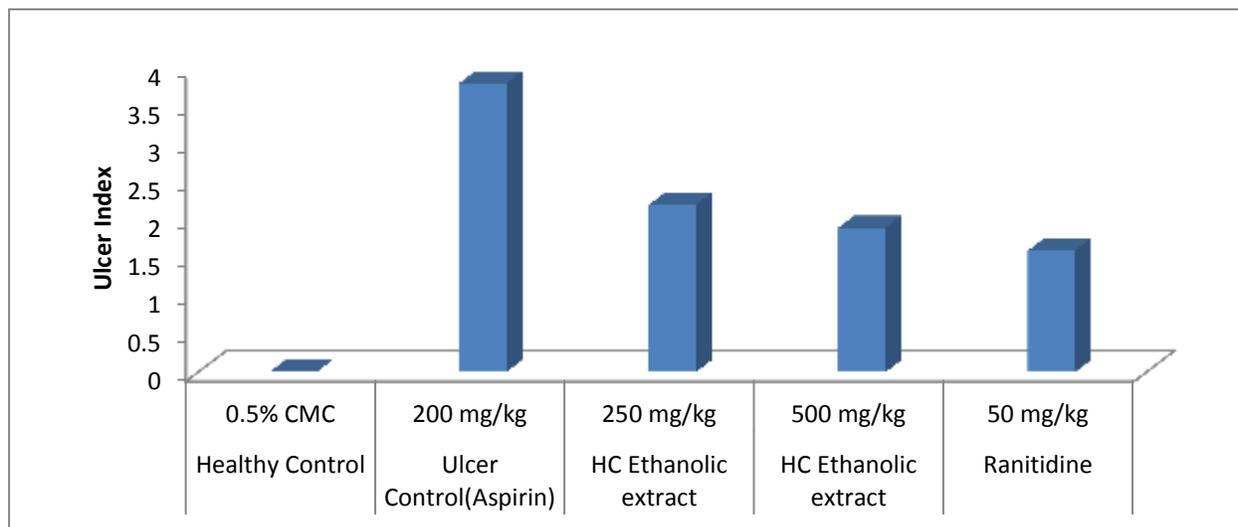


Figure 1: Effect of *Houttuynia cordata*, Thumb on ulcer index.

Effect of *Houttuynia cordata*, Thumb extract on ulcer index in the stomach of aspirin plus pylorus-ligated rats. *Houttuynia cordata*, Thumb 250 and 500 mg/kg and ranitidine 50 mg/kg showed 32.70, 45.94 and 51.35% inhibition of ulcers, respectively.

CONCLUSION

Prevalence of peptic ulcer disease is reported as one of the major diseases. Alcohol consumption is one of the reasons for the disease. From the present animal model study it is proved that *Houttuynia cordat*, Thumb extract is potent antiulcer and gastro-protective agent. Treatment with this plant extract in ulcer induced rats reduced the offensive factors such as ulcer index and total acidity of gastric juice. It was proved that the performance of *Houttuynia cordata*, Thumb extract showed similar results to standard drug, Ranitidine (Table 2-3). In continuation to the present investigation of, it is planned to isolate and elucidate the structure of the active molecules from the plant which are responsible for antiulcer activity and further clinical studies with these molecules will provide important clue to produce and/or develop a highly potent antiulcer drug.

REFERENCE

1. Falk GW. Cecil essentials of medicine. 5th ed., Edinburgh: WB Saunders Company; 2001: 334-43.
2. Tripathi KD. Essentials of Medical Pharmacology. New Delhi: Jaypee Brothers Medical Publishers (P) Ltd; 1999: 628- 42.
3. Tewari PV, Kumar N, Sharma RD, Kumar A. Treatment of *Amlapitta* (Khila-Sthana). Varanasi: Chaukhamba Visva Bharati; 1996: 630-35.

4. Ariyphisi I, Toshiharu A, Sugimura F, Abe M, Matsuo Y, Honda T. Recurrence during maintenance therapy with histamine H₂ receptors antagonist in cases of gastric ulcers. *Nikon University J of Medical* 1986. 28: 69-74.
5. Sairam K, Rao CV, Goel RK. Effect of *Centella asiatica* linn on physical and chemical factors induced gastric ulceration and secretion. *Indian J Exp. Biol* 2001. 39:137-42.
6. Sairam K, Rao CV, Goel RK. Effect of *Convolvulus pluricaulis* Chois on gastric ulceration and secretion in rats. *Indian J Exp Biol* 2001. 39: 350-54.
7. Jiechao Y, Guangxing L, Jing L, Qing Y, Xiaofeng R. In vitro and in vivo effects of *Houttuynia cordata* on infectious bronchitis virus. *Avian Pathology*. 2011. 40(5): 491-98.
8. Zheng, HZ, Dong ZH, She J. *Houttuynia cordata*. *Modern Study of Traditional Chinese Medicine* 1998. 3: 2983-03
9. Li GZ, Chai OH, Lee MS, Han EH, Kim HT, Song CH. Inhibitory effects of *Houttuynia cordata* water extracts on anaphylactic reaction and mast cell activation. *Biological Pharmaceutical Bulletin*,2005. 28: 1864-68.
10. Park E, Kum S, Wang C, Park SY, Kim BS, Schuller-Levis G. Anti-inflammatory activity of herbal medicines: inhibition of nitric oxide production and tumor necrosis factor-alpha secretion in an activated macrophage-like cell line. *American Journal of Chinese Medicine* 2005. 33: 415-24.
11. Kim IS, Kim JH, Kim JS, Yun CY, Kim DH, Lee JS. The inhibitory effect of *Houttuynia cordata* extract on stem cell factor-induced HMC-1 cell migration. *Journal of Ethnopharmacology*. 2007. 112: 90-95.
1. 12. Lu HM, Liang YZ, Yi LZ, Wu XJ. Anti-inflammatory effect of *Houttuynia cordata* injection. *Journal of Ethnopharmacology*.2006.104: 245-49.
12. Chiang LC, Chang JS, Chen CC, Ng LT, Lin CC. Anti-Herpes simplex virus activity of *Bidens pilosa* and *Houttuynia cordata*. *American Journal of Chinese Medicine*. 2003. 31: 355-62.
13. Hayashi K, Kamiya M, Hayashi T. Virucidal effects of the steam distillate from *Houttuynia cordata* and its components on HSV-1, influenza virus, and HIV. *Planta Medica*.1995.61: 237-41.
14. Lau KM, Lee KM, Koon CM, Cheung CS, Lau CP, Ho HM, Lee MY, Au SW, Cheng CH, Lau CB, Tsui SK, Wan DC, Waye MM, Wong KB, Wong CK, Lam CW, Leung PC, Fung KP. Immunomodulatory and anti-SARS activities of *Houttuynia cordata*. *Journal of Ethnopharmacology*. 2008. 118:79-85.

15. Haywood VH, Capparaceae. Flowering plants of the world, Oxford: 1978. 119
16. Cook, Oriental Herbs and Vegetables. Brooklyn Botanic Garden: 1986.39(2):76
17. Barley SL, A Barefoot Doctors Manual. J R Coll Gen Pract. 1979. 29(199): 121.
18. Kariyone T, Atlas of Medicinal Plants. Phytochemistry. 1971. 9(3): 591-93
19. Yeung HC, Handbook of Chinese Herbs and Formulas. Institute of Chinese Medicine. Los Angeles. 1985.
20. Duke JA, Ayensu ES. Medicinal Plants of China, Rev Inst Med Trop. Sao Paulo. 1985. 48(1):33-37.
21. Bown D. Encyclopaedia of Herbs and their Uses. Dorling Kindersley, London: **1995**.
22. Kokate CK. Practical Pharmacognosy. New Delhi: Vallabh Prakashan; 1994; 14:178-82.
23. Harborne JB. Phytochemical Method. New York: Chapman and Hall; 1984: 55-82.
24. Sen S, Asokkumar K, Umamaheswari M, Sivashanmugam T, Subhadradevi V. Antiulcerogenic effect of gallic acid in rats and its effect on oxidant and antioxidant parameters in stomach tissue. Indian journal of Pharmaceutical Sciences 2013.
25. Dashputre NL, Naikwade NS. Evaluation of Anti-Ulcer Activity of Methanolic Extract of *Abutilon indicum* Linn Leaves in Experimental Rats. International Journal of Pharmaceutical Sciences and Drug Research 2011; 3(2): 97-100.

AJPTR is

- Peer-reviewed
- bimonthly
- Rapid publication

Submit your manuscript at: editor@ajptr.com

