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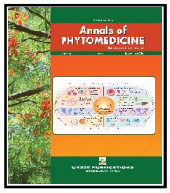

Original Article : Open Access

Evaluation of antiarthritic activity of hydroethanolic leaf extract of *Houttuynia cordata* Thunb. in rats

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Abstract

Houttuynia cordata Thunb. is an ethnobotanically important plant of North Eastern region of India. The plant has been traditionally utilized for its properties that reduce inflammation and combat oxidation. The present study was taken to evaluate the antiarthritic activity of hydroethanolic extract of *H. cordata* (HEHC) leaves in CFA (Complete Freund's Adjuvant) induced Wistar rats arthritic condition. With the exception of the normal control group (Group I), all rats received a single intradermal injection of CFA (0.1 ml) on the right hind paw to develop arthritis. The positive control group (Group II) received 0.1 ml CFA alone. Group III served as standard control and received oral suspension of Meloxicam @ 5 mg/kg body weight. In Groups IV, V and VI of arthritic induced rats received oral administration of HEHC @ 100, 300 and 900 mg/kg body weight, respectively, from the 14th day onwards with 1ml distilled water as vehicle. The antiarthritic activity was evaluated based on parameters like changes in body weight, paw volume, arthritic score, hematological parameters like RBC count, haemoglobin (Hb) count, WBC count, platelet count and serum biochemical parameters like AST, ALT, ALP, creatinine, BUN and MDA. The results showed that HEHC @100, 300 and 900 mg/kg (body weight) had significant (p<0.01) antiarthritic activity against CFA-induced arthritis in rats. HEHC administered @ 900 mg/kg body weight showed the highest antiarthritic effect. The findings of the present study were supported by the histopathological examination of the ankle joint section revealed restructured synovial membrane in groups administered with HEHC.

1. Introduction

Rheumatoid arthritis (RA) is a chronic systemic autoimmune and inflammatory disease which mainly attacks the small joints in hands, wrists and knees (Bullock *et al.*, 2018). In autoimmune conditions, Inflammation results when the body's immune system unintentionally targets its own healthy tissues, such as joints. Pain, synovial membrane inflammation, peripheral joint inflammation, joint stiffness, articular tissue degradation, and limited joint mobility are the hallmarks of RA. The cause of RA is unknown, and its prognosis is guarded (McInnes and Schett, 2011). At present, there is no cure for RA, only symptomatic treatments is given with its main aim to reduce inflammation, relieve pain, stop joint damage and prevent disability (Han *et al.*, 2004). Analgesics, non-steroidal anti-inflammatory drugs (NSAIDs), corticosteroids, and disease modifying anti-rheumatic drugs (DMARDs) are commonly used in treatment, immunosuppressive drugs and biologics; but these can cause unwanted side effects like infections, headaches, nausea, allergic reactions, *etc*. If RA is left untreated, larger joints are affected first, followed by the skin, eyes, heart, kidneys, and lungs. RA is the most prevalent inflammatory disease, affecting around 1% of adult humans (Rossini *et al.,* 2014) worldwide and women are three times more likely than men to have RA. It has also been reported that more than 350 million people have arthritis globally (Global RA Network, 2021) and the cost of arthritis in US was estimated to be more than 303 billion per annum (CDC, 2020). As a result, there is growing interest to find alternative therapy including herbs for the treatment and prevention of arthritis. Traditional medicine practitioners claim that some herbal preparations detoxify toxins in the body, cleanse the body of such toxins, and ultimately modulate the immune system.

Houttuynia cordata Thunb. (Family-Saururaceae) is a rhizomatous, herbaceous, and perennial plant also referred to as rainbow plant, chameleon, fish-wort, fish mint, heart leaf, lizard's tail, gatha (Tenyidie) in different parts of India and mosundori locally in Assam. It is used traditionally for several purposes including anti-inflammatory and antioxidant action. It is indigenous to the hilly area of Southeast Asia and is found up to an elevation of 2500 m (Rathi *et al.*, 2014).

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Pneumonia, SARS, sores, ulcers, heatstroke, diarrhea, and dysentery are all treated with it in traditional Chinese medicine (Lau *et al*., 2008; Chiang *et al*., 2003). In Japan, free radicals were eliminated, inflammation was decreased, and the immune system was strengthened by combining "Dokudami Cha," a beverage produced from an infusion of *H. cordata* herbs leaves with other herbal medicines. The leaves were used by native Naga tribes of northeast India as a cure for intestinal helminthic infections (Yadav and Temjenmongla, 2011) and the entire plant was used to relieve stomach ache (Laloo and Hemalatha, 2011). The plant is also used in allergic cases (Pradhan *et al*., 2023) and boosts immunity by enhancing the immune barriers of the vagina, intestines, and other organs (Wu *et al*., 2021). Keeping in view of the apply of *H. cordata* in various inflammatory situations, the present study was undertaken to evaluate the antiarthritic efficacy of *H. cordat*a in Complete Freund's Adjuvant (CFA) induced arthritic rats.

2. Materials and Methods

2.1 Experimental animals

Adult healthy albino rats of both sexes weighing 150-200 g were purchased from Animal House Facility., College of Veterinary Science, AAU, Khanapara-781022, Assam, India. Every animal was housed in cages made of polypropylene and kept in a standard laboratory settings, (12:12 h light/dark cycle) at room temperature ranging between 22-25°C with standard balanced diet and *ad libitum* clean drinking water. The study was performed in accordance with the guidelines for the use and care of laboratory animals approved by Institutional Animal Ethical Committee of CVSc, AAU (Approval No. 770/GO/Re/S/03/CPCSEA/FVSc/AAU/IAEC/23-24/1095 dated 11.08.2023).

2.2 Drugs and chemicals

Freund's Complete Adjuvant (FCA) was acquired from Sigma-Aldrich (St. Louis, Missouri, USA). Meloxicam and Malondialdehyde (MDA) were purchased from Intas Pharmaceuticals (India) and Elabscience (Texas, USA) respectively. Biochemical kits to estimate ALT, AST, ALP, Creatinine and BUN were purchased from ERBA, Aspen Laboratories, India.

2.3 Collection, preparation and authentication of leaves of *Houttuynia cordata* Thunb.

Fresh healthy leaves of *H. cordata* Thunb. were collected from in and around Guwahati, (Assam, India) for the study. The taxonomy of the plant was authenticated by The Botanical Survey of India (BSI), Eastern Regional Centre, Shillong, Meghalaya (File No. BSI/ERC/Tech/2023-24/1081). The accumulated leaves were shade dried at room temperature and then grounded to fine powder. The method described by Mallmann *et al*. (2018) was followed for the extraction and preparation of the hydroethanolic extract of *Houttuynia cordata* Thunb. leaves. The powdered leaves were extracted with ethanol and water (50% v/v) by dipping for 72 h at room temperature. The mixture was filtered through a Buchner funnel using muslin cloth and Whatman filter paper No. 1 multiple times after being agitated at regular intervals. The resulting filtrate was concentrated using a rotary evaporator at 40-45°C, and it was then dried off in a hot water bath at 50-60°C.

2.4 Phytochemical screening of the leaf extract

The hydroethanolic extract underwent phytochemical analysis to identify several classes of phytochemicals, including steroids, alkaloids, phenolic compounds, tannins, flavonoids, glycosides, and saponins, following the method outlined by Harborne (1998).

2.5 Acute toxicity study

The acute toxicity study was conducted in accordance with Organization of Economic Co-operation and Development (OECD) 423 guidelines.

2.6 Experimental design

Thirty-six numbers of Wistar rats of almost similar body weight (150-200 g) and age of either sex was divided randomly into six different groups containing six animals in each group. Group I considered as normal control group, the positive control group (Group II) received 0.1ml CFA for induction of arthritis without treatment, the standard control group (Group III) received Meloxicam @5 mg/kg body weight orally, the treatment groups, *viz*., Groups IV, V and VI received HEHC extract @ 100, 300 and 900 mg/kg body weight orally from the 14th day onwards with 1ml distilled water as vehicle till 28th day.

2.7 Freund's complete adjuvant induced arthritis

Arthritis was triggered in each group, apart from the normal control group (Group I), through a single intradermal injection of 0.1 ml of CFA that included 1mg/ml *Mycobacterium tuberculosis* H37Ra suspension in sterile paraffin oil into the foot pad of the right hind paws of the rats (Dhakad *et al*., 2018).

2.8 Assessment of paw volume

Paw volume of experimental animals were taken with the help of digital pleythysmometer at weekly interval from 14th to 28th day.

% Inhibition of paw volume = (Control – N day/Control) × 100%

2.9 Assessment of body weight

Body weight was taken on 0, 7th, 14th, 21st and 28th day with the help of weighing balance.

Per cent body weight change= (N Day – 0 Day/0 Day) × 100%

2.10 Assessment of arthritic index score

The arthritic index (AI) scoring was done by using the procedure of Pan *et al*. (2017). AI score was estimated from the characteristics of redness, erythema, and severity of swelling. The paws were checked for severity of the condition regularly starting from the 7th day till the 28th day. The severity of arthritis was evaluated by a five-grade scoring scale as, 4 = swelling from ankle joints to the entire paw, 3 = swelling from toes to ankle joints, 2 = swelling of toes and toe joints, 1= erythema or swelling of toes joints, 0 = no erythema or swelling. The maximum arthritic score was 16, and each rat's AI score was the total of its four limbs.

2.11 Haematological estimation

The haematological parameters like red blood cell (RBC) count, haemoglobin (Hb) count, white blood cell (WBC) count and platelet count were estimated for all groups of the experimental animals.

2.12 Biochemical estimation

Serum biochemical characteristics such as aspartate aminotransferase (AST), alanine transaminase (ALT), alkaline phosphatase (ALP), creatinine, blood urea nitrogen (BUN) and malondialdehyde (MDA) were estimated in all the experimental animals with standard biochemical kits.

2.13 Histopathological analysis

For histopathological study rats were humanely sacrificed on 28th day as per standard protocol. The ankle joints of the sacrificed rats were cut off from the hind limb and processed for histopathological studies.

2.14 Statistical analysis

The data obtained from the present study was performed by MS-excel and Prism Graphpad version 5 to compute the mean, analysis of variance (ANOVA), and standard error of mean (SEM) using standard method.

3. Results

3.1 Percentage yield of HEHC

The extractability percentage was found to be 20.5%.

3.2 Phytochemical screening of HEHC

The hydroethanolic extract of *H. cordata* was quantitatively analyzed for the presence of different phytochemicals. The phytochemical analysis of the hydroethanolic extract of *H. cordata* in the present study revealed the existence of steroids, alkaloids, tannins, flavonoids, glycosides, phenolic compounds and saponins.

3.3 Acute toxicity study

Six rats of either sex were fed orally with the hydroethanolic leaves extract of *H. cordata* @2000 mg/kg body weight in a step wise manner of 3 rats per step. The animals were observed for 24 h and there was no mortality, behavioral alteration or symptoms of abnormality. The animals were monitored for a further 14 days, and no deaths were reported. Hence, the extract was regarded as safe up to a maximum dosage of 2000 mg/kg body weight (OECD 423).

3.4 Body weight change

Notable (p<0.01) decrease in the body weight of group of the rats treated with CFA was observed as compared with normal group (Figure 1). The body weight of standard group (Group II) and the test groups treated with HEHC (Groups IV, V and VI) showed significant increase in body weight (p<0.01) after 14th day (day of commencement of treatment) onwards till 28th day as compared to CFA control group. The effect of HEHC @300 mg/kg body weight and 900 mg/kg body weight showed no significant difference (p<0.01) compared to the standard group (Group III) in respect to the alteration in body mass of experimental rats. The per cent gain of body weight in normal and standard group was found to be 22.96% and 11.23%, respectively, while that of HEHC @100, 300 and 900 mg/kg body weight was found to be 4.78%, 9.82% and 14.14%, respectively. The result indicated that rats treated with HEHC @ 900 mg/kg body weight demonstrated higher gain in body weight than that of rats of standard and other treatment groups.

3.5 Paw volume change (% inhibition) of CFA injected paw

The volumes of the right hind paw in all CFA treated groups significantly (p<0.01) increased when compared to the normal control group (Figure 2). Group III treated with Meloxicam as well as groups treated with HEHC @100, 300 and 900 mg/kg body weight showed significant (p<0.01) reduction in paw volumes after 14th day onwards till 28th day. The per cent inhibition of paw volume on 28th day was found to be 58.41%, 20%, 14.38%, 17.50% and 18.13% for positive control, standard and HEHC treated groups @100, 300 and 900 mg/kg body weight, respectively.

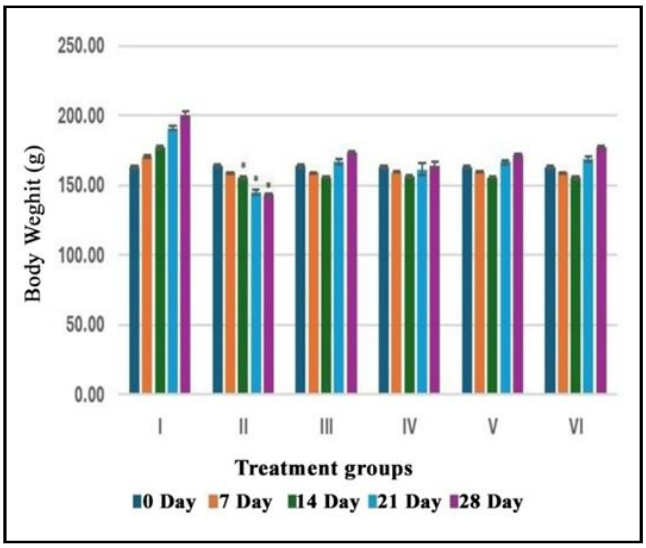


Figure 1: Graphical representation of hydroethanolic leaf extract of *H. cordata* and Meloxicam on body weight change in CFA induced arthritic rats.

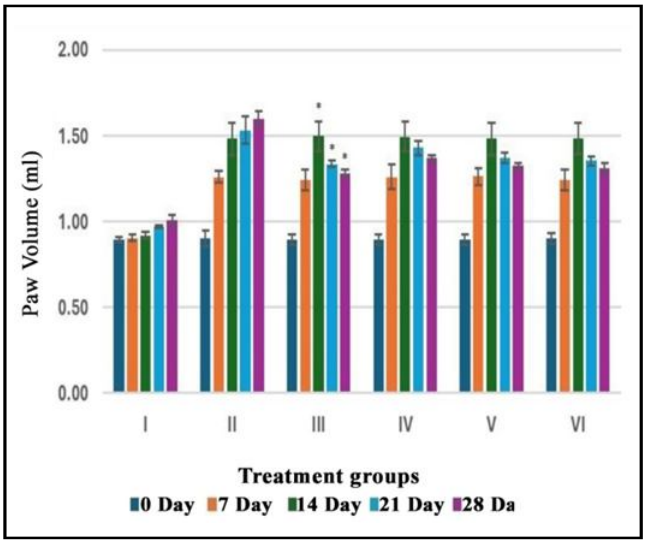


Figure 2: Graphical representation of hydroethanolic leaf extract of *H. cordata* and Meloxicam on paw volume in CFA induced arthritic rats.

3.6 Arthritis score

The arthritis score was assessed weekly starting from 7th day till 28th day (Table 1). The arthritis score of normal control group (Group I)

is considered zero as arthritis was not induced in the rats of this group. The arthritis score of positive control, standard and groups treated with HEHC @100, 300 and 900 mg/kg body-weight on 28th day of treatment was obtained to be 9.00 ± 0.24, 2.68 ± 0.17, 4.32 ± 0.16, 2.78 ± 0.16 and 2.85 ± 0.11, respectively. HEHC @300 and 900 mg/kg body weight showed comparable effect with the standard group. The rats treated with HEHC @300 (Group V) and 900 mg/kg body weight (Group VI) showed significant (p<0.01) and greater antiarthritic effect than the Group IV rats (HEHC @ 100 mg/kg body weight) indicating a dose dependent increase in anti-arthritic effect of *H. cordata* hydroethanolic leaf extract in rats.

Table 1: Effect of hydroethanolic leaf extract of *H. cordata* on arthritis score

Groups	Arthritis score			
	7 Day	14 Day	21 Day	28 Day
I (Normal)	0.00	0.00	0.00	0.00
II (Positive control)	4.17 ± 0.48	11.67 ± 0.42	11.83 ± 0.31	9.00 ± 0.24
III (Standard)	4.01 ± 0.34	12.00 ± 26	5.35 ± 0.36[a]	2.68 ± 0.17[a]
IV (HEHC @100 mg/kg body weight)	3.87 ± 0.34	12.00 ± 0.45	6.38 ± 0.17[ab]	4.32 ± 0.16[ab]
V (HEHC @300 mg/kg body weight)	3.98 ± 0.34	12.17 ± 0.17	5.47 ± 0.10[a]	2.78 ± 0.16[ac]
VI (HEHC @900 mg/kg body weight)	4.00 ± 0.34	11.83 ± 0.31	5.58 ± 0.14[a]	2.85 ± 0.11[ac]

Values are the Mean ± S. E. for six replicates. Mean value in each row bearing common superscripts do not differ significantly at p<0.01.

3.7 Haematological parameters

In comparison to the normal group, the RBCs and Hb decreased significantly while that of WBCs and Total platelets increased significantly (p<0.01) in the CFA treated Groups (II, III, IV, V and VI). The RBC count (Figure 3) and Hb level (Figure 4) in the treatment Groups (III, IV, V and VI) significantly (p<0.01) increased after day 14th (1st day of treatment), while the WBC (Figure 5) and Total Platelet Count (Figure 6) significantly (p<0.01) decreases.

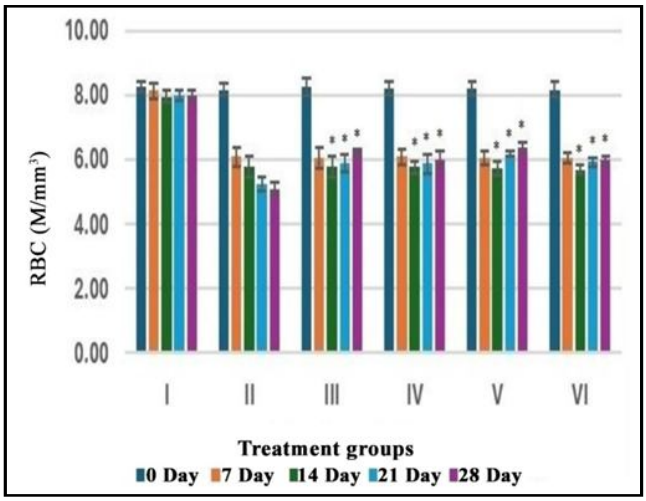


Figure 3: Graphical representation of hydroethanolic leaf extract of *H. cordata* and Meloxicam on RBC count in CFA induced arthritic rats.

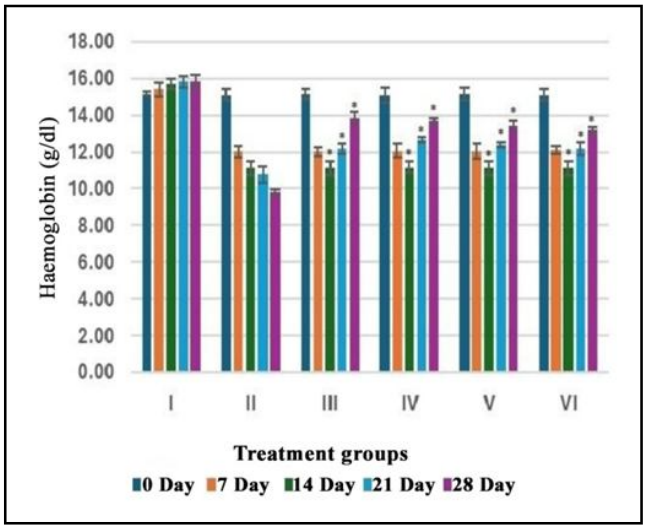


Figure 4: Graphical representation of hydroethanolic leaf extract of *H. cordata* and Meloxicam on Hb count in CFA induced arthritic rats.

3.8 Biochemical parameters

The ALT activity of CFA induced groups showed significant (p<0.01) increase from day 14th (start of treatment) onwards. The results of this investigation indicated that the ALT activity in the treatment groups was significantly (p<0.01) reduced from 21st day onwards as compared with the positive control group. On the 28th day, all the treatment Groups (III, IV, V and VI) showed no significant difference in ALT activity in comparison with the normal control group (Figure 7).

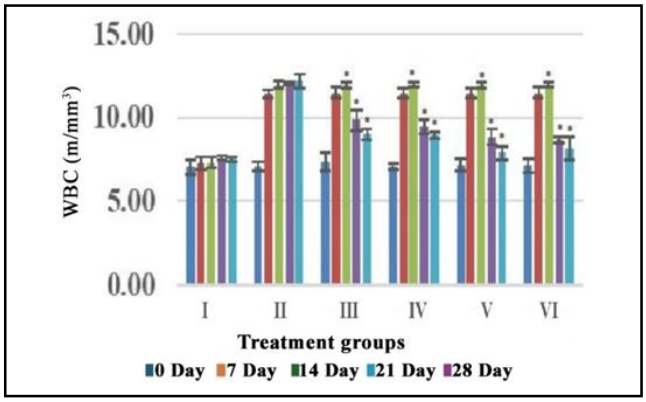


Figure 5: Graphical representation of hydroethanolic leaf extract of *H. cordata* and Meloxicam on WBC count in CFA induced arthritic rats.

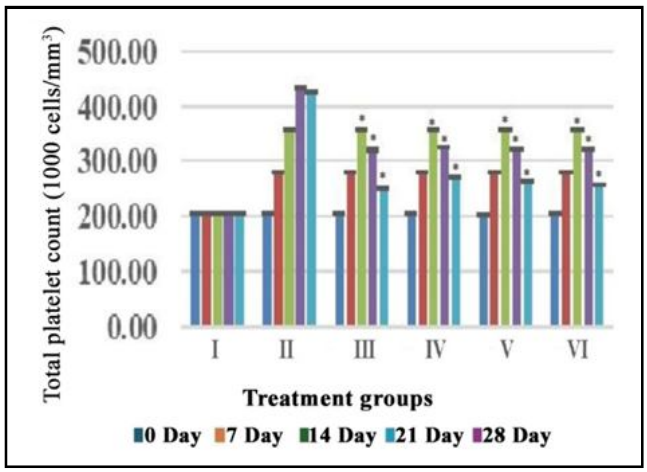


Figure 6: Graphical representation of hydroethanolic leaf extract of *H. cordata* and Meloxicam on Total platelet count in CFA induced arthritic rats.

The activity of AST in CFA induced groups significantly (p<0.01) increased from 7th day onwards. After initiation of treatment, *i.e.*, from 14th day onwards, there was significantly (p<0.01) reduction in the AST activity in the experimental groups as related to the positive control group. There was no significant difference (p<0.01) between standard and HEHC @100 mg/kg body weight treated groups on the 21st day of experiment. However, the AST values of both the groups treated with HEHC @300 and 900 mg/kg body weight were significantly (p<0.01) different as judged with positive control group on the 21st day of the experiment. But, there is no significant difference (p<0.01) among Groups IV, V and VI on 28th day of treatment. The present result suggested that Group VI exhibited greater activity in comparison with the standard and other treated groups (Figure 8).

The ALP level of CFA treated groups were significantly (p<0.01) increased from the 7th day onwards as related to that of the normal control group. The level of ALP significantly (p<0.01) decreased in all the treatment groups on the 28th day in comparison to the positive control group, and there was no notable difference with the normal (Group I) and standard group (Group II) (Figure 9).

The level of creatinine was significantly (p<0.01) increased in CFA induced groups from the 7th day onwards. After the commencement of the treatment (*i.e.*, from the 14th day onwards), there was notable (p<0.01) reduction in the level of creatinine experimental groups. The serum level of creatinine on the 28th day was found to be 0.37 ± 0.02, 0.61 ± 0.02, 0.40 ± 0.04, 0.45 ± 0.01, 0.52 ± 0.02, 0.41 ± 0.03 in Groups I, II, III, IV, V and VI, respectively. The serum level of creatinine of standard group (Group III) and HEHC @900 mg/kg body weight (Group VI) showed no significant difference (p<0.01) on 28th day, while significant difference (p<0.01) in the level of creatinine was observed between Groups IV and V and Group III treated with hydroethanolic extract of *H. cordata* (Figure 10).

The experimental findings of the present study suggested significant increase (p<0.01) in the BUN level in CFA induced groups up to 14th day of experiment. The BUN levels of experimental groups (Groups III, IV, V and VI) showed significant difference (p<0.01) with the positive control group from 21st day onward, while there was no significant difference observed on day 28th among Groups I, III, IV, V and VI (Figure 11).

The MDA values of CFA induced groups significantly (p<0.01) increased from the 7th day onwards when evaluated with the normal control group. In the treatment groups, the MDA levels in Groups III, IV, V and VI were significantly (p<0.01) lower on the 21st and 28th day when referred with the positive control group (Group III). The MDA value of HEHC treated group @100 mg/ kg body weight showed significant (p<0.01) difference with the standard group on the 28th day, but MDA values in the rats treated with HEHC @300 and 900 mg/kg body weight showed no notable difference with the standard group, suggesting comparable effect with the standard group (Figure 12).

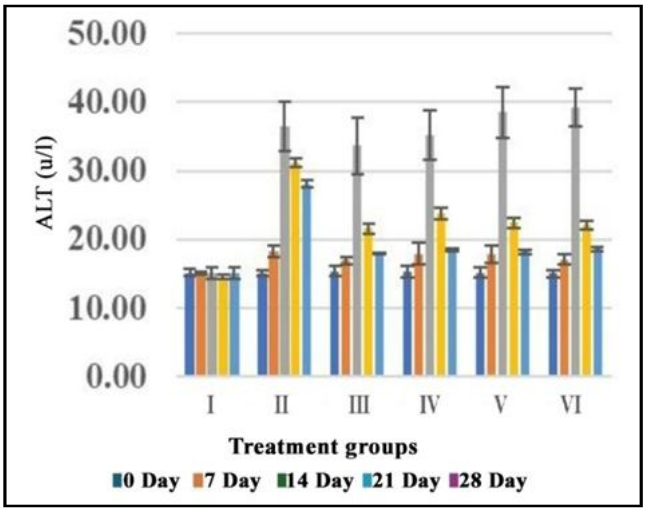


Figure 7: Graphical representation of effect of HEHC and Meloxicam on ALT in CFA induced arthritic rats.

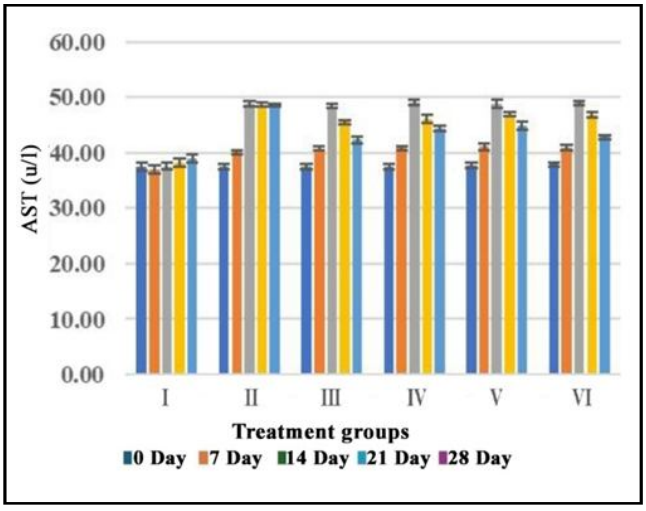


Figure 8: Graphical representation of effect of HEHC and Meloxicam on AST in CFA induced arthritic rats.

3.9 Histopathological observation

The histopathological examination of the normal control group (Group I) revealed normal cellular structure with epidermis lined by stratified squamous epithelium and dermis composed of fibro collagenous stroma. While the histopathological sections of CFA

treated group revealed inflammation where dermis was infiltrated with mononuclear inflammatory cells, giant cell, and epithelioid cells as well as oedema and necrosis. The histopathological section of the meloxicam treated group (Group III) revealed epidermis lined by stratified squamous epithelium and less infiltration of cells. The HEHC @100 mg/kg body weight treated group (Group IV) showed synovial hyperplasia, swelling of endothelial cells in blood vessels, congestion and cell infiltration; whereas, in HEHC @300 mg/kg body weight treated group (Group V) showed restructured synovial membrane with mild infiltration of mononuclear cells. The HEHC @900 mg/kg body weight treated group (Group VI) showed restructured synovial membrane (Figure 13).

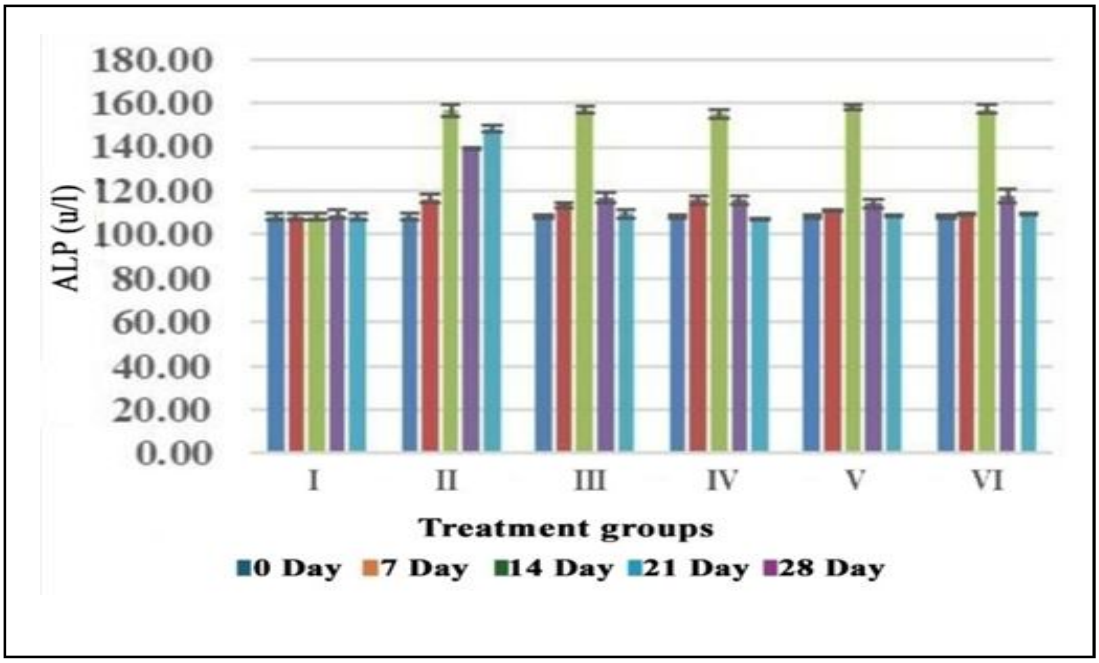


Figure 9: Graphical representation of the effect of HEHC and Meloxicam on ALP in CFA induced arthritic rats.

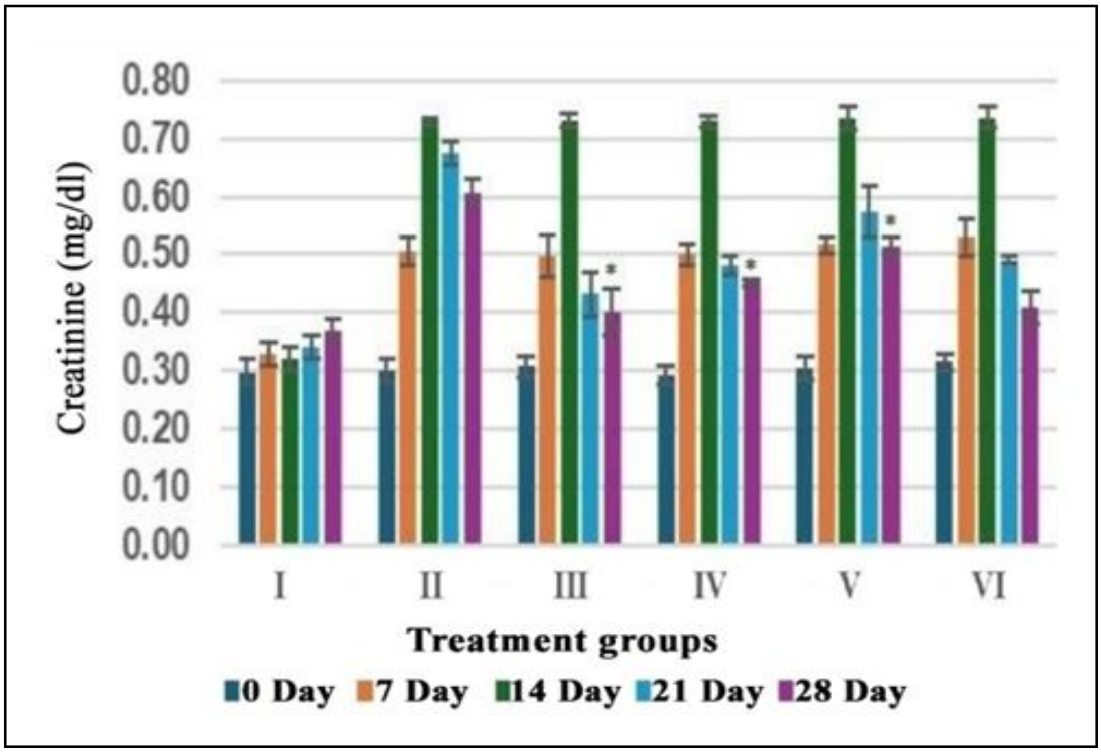


Figure 10: Graphical representation of the effect of HEHC and Meloxicam on creatinine in CFA induced arthritic rats.

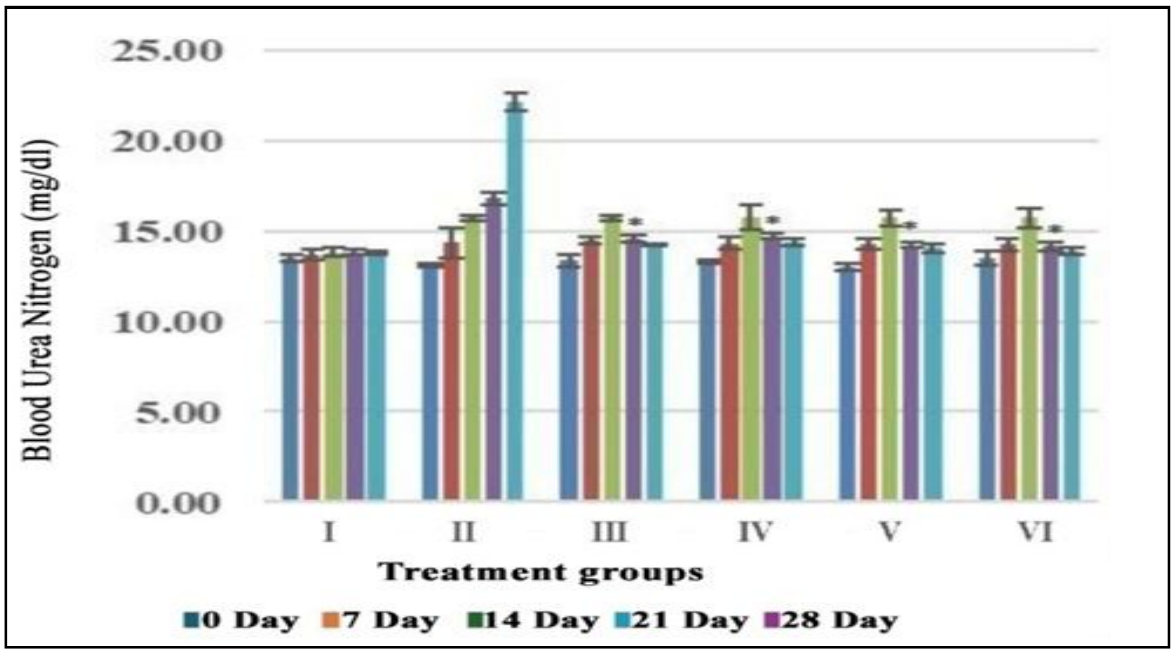


Figure 11: Graphical representation of the effect of HEHC and Meloxicam on BUN in CFA induced arthritic rats.

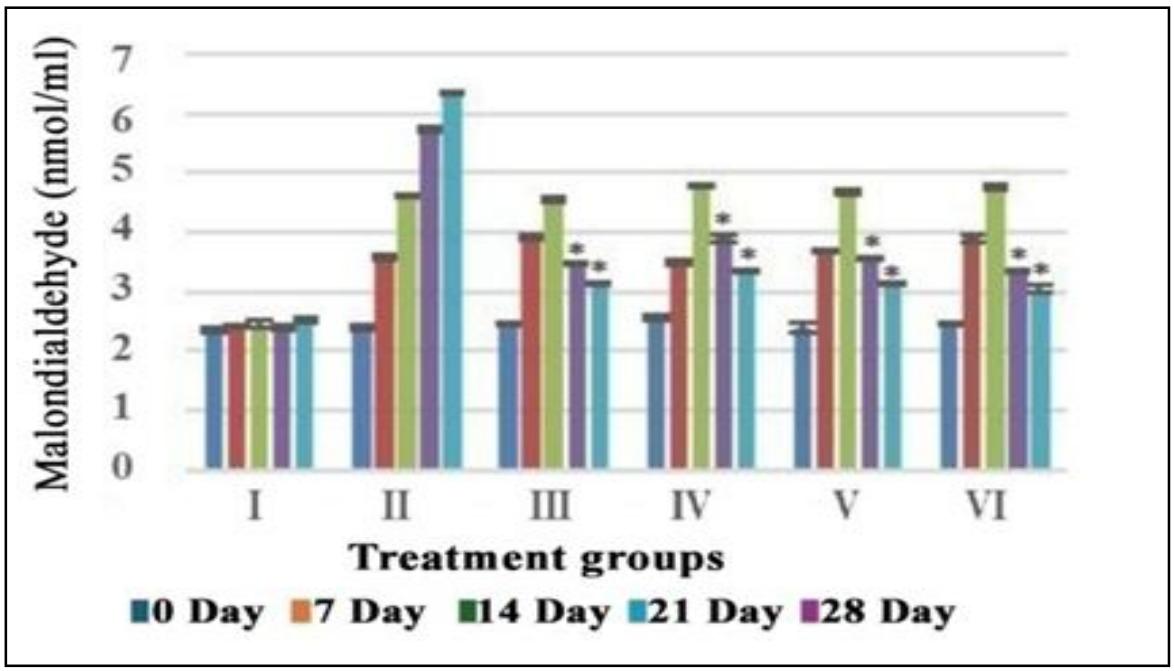
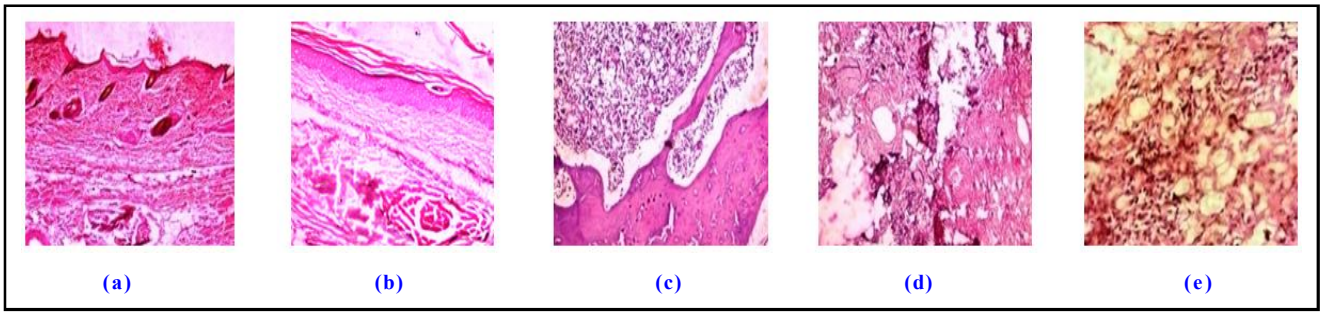


Figure 12: Graphical representation of effect of HEHC and Meloxicam on MDA in CFA induced arthritic rats.



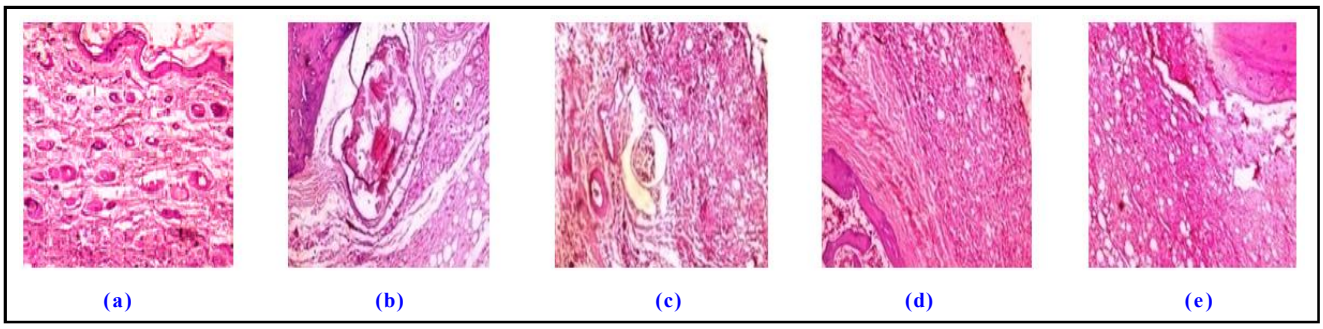


Figure 13: (a) Histopathological section of Group I (Normal) shows epidermis lined by stratified squamous epithelium, (b) Histopathological section of Group II (normal) shows dermis composed of fibro collagenous stroma, (c) Histopathological section of Group II (positive control) shows dermis infiltrated with mononuclear inflammatory, (d) Group II (Positive control) reveals dermis showing edema and necrosis, (e) Histopathological section of Group II (positive control) shows dermis with giant cell, mononuclear cells and epithelioid cells, (f) Histopathological section of Group III (Meloxicam) revealed epidermis lined by stratified squamous epithelium and less infiltration of cells, (g) Histopathological section of Group III shows restructuring of synovial membrane (h) Histopathological section of Group IV (100 mg/kg body wt.) shows synovial hyperplasia, swelling of endothelial cells in blood vessels, congestion and cell infiltration. (i) Histopathological section of Group V (300 mg/kg body wt.) shows restructured synovial membrane with mild infiltration of mononuclear cells, (j) Histopathological section of Group VI (900 mg/kg body wt.) shows restructured synovial membrane.

4. Discussion

4.1 Phytochemical screening of HEHC

Analysis of phytochemicals of the hydroethanolic extract of *H. cordata* carried out in this study demonstrated the existence of steroids, alkaloids, tannins, flavonoids, glycosides, phenolic compounds, and saponins. Woranam *et al.* (2020) reported similar findings of *H. cordata* extracts having strong anti-inflammatory properties. Additionally, Rafiq *et al.* (2022) found that *H. cordata* holds a range of chemical components that have distinctive therapeutic properties and belong to various chemical classes, including alkaloids, essential oils, and flavonoids. Besides major components like essential oil and flavonoids, alkaloids are present in abundant quantity and these phytochemicals are known to exert pharmacological activities (Ahn *et al*., 2017; Ma *et al*., 2017)

4.2 Body weight change

In the present experiment, rats treated with HEHC (at 100, 300, and 900 mg/kg body-weight) showed increased body weight; with the highest dose (900 mg/kg body weight) exhibiting the most significant gain (14.14%). The HEHC-treated groups (300 and 900 mg/kg body weight) showed no significant increases in body weight compared to the standard group. Notably, the 900 mg/kg body weight HEHC group showed comparable results to the standard group, indicating potential benefits of HEHC treatment.

Patil *et al.* (2012) reported that arthritis is linked with the loss of lean body mass and weight and that is known as rheumatoid cachexia. Decrease in body weight in the present study may be due to stress. Similar reports were made by Tatiya *et al*. (2017), Dhakad *et. al.* (2018), Alzarea *et al*. (2022). The rise in body weight among treatment groups is due to the protective effect of the plant extract antioxidant, anti-inflammatory, *etc*., as Rafiq *et al*. (2022). Sakuludomkan *et al.* (2021) reported a similar observation of a gradual increase in body weight in Wister rats after feeding of *H. Cordata* leaf extract, a natural herb rich in antioxidants and many beneficial phytochemicals with active ingredients, which fully supported protective role of the plant extract in restoring and increasing body weight.

4.3 Paw volume change (% inhibition) of CFA injected paw

Treatment with Meloxicam (standard) and HEHC (at doses of 100, 300, and 900 mg/kg body weight) significantly reduced hind paw volumes in rats, indicating anti-inflammatory effects. The percentage inhibition of paw volume on the 28th day was found to be 58.41% for the positive control group, 20% for the standard (Meloxicam) group, 4.38%, 17.50%, and 18.13% for HEHC groups at 100, 300, and 900 mg/kg body weight, respectively. The results suggest that HEHC exhibits dose-dependent anti-inflammatory activity.

Reduction in paw volume after treatment of *H. Cordata* leaf extract was seen as revealed by phytochemical studies in compliance with Rafiq *et al*. (2022); and Pradhan *et al*. (2023) which may be due to inhibition of the production of inflammatory mediators like NO and PGE_2 and inflammatory cytokines. In an *in vivo* study carried out by Chun *et al.* (2022) with *H. cordata* essential oil-containing aerosol formulation (H16) in rat ear oedema model found that treatment with H16 at medium (66 µg/rat) and high doses (132 µg/rat) reduced oedema formation by 50.4% and 38.4%, respectively compared to decrease in ear oedema by 63.8% in rats with 10 mg/kg body weight of Indomethacin administration (p<0.01). These results suggested that H16, particularly at medium and high doses, has a strong anti-inflammatory effect *in vivo*. In another *In vivo* study conducted by Chen *et al.* (2014) showed that sodium houttuyfonate, which showed more anti-inflammatory action than 2-methyl nonyl ketone, dramatically decreased xylene-induced ear edema and inflammation in mice. Furthermore, formaldehyde and carrageenan-induced foot edema in mice were effectively reduced by the volatile oil components of *H. cordata* (Li *et al.*, 2013).

4.4 Arthritis score

The findings of this study demonstrated that HEHC at doses of 300 and 900 mg/kg body weight exhibited significant and comparable antiarthritic effects with the standard treatment, with a dose-dependent increase in efficacy. The arthritis scores in the HEHC-treated groups (300 and 900 mg/kg) were significantly lower compared to the 100 mg/kg body weight dose and positive control

group on the 28th day, indicating potential therapeutic benefits of HEHC in arthritis.

Li *et al*. (2014); Li and Zhao (2015) demonstrated that sodium houttuyfonate has potential therapeutic activity in rheumatoid arthritis, a condition characterized by joint destruction due to the abnormal overgrowth of the synovium. In an *in vitro* experiments using synovial cells, sodium houttuyfonate, significantly reduced the synovial cell proliferation in a manner that depends on the dosage within the concentration range of 25 µg/ml to 200 µg/ml. In the study conducted by Li *et al*. (2011); and Shin *et al*. (2010), found that *H. cordata* supercritical extract (HSE) can reduce the production of inflammatory markers such as tumor necrosis factor (TNF) α and prostaglandin E2 (PGE2) in a carrageenan-induced inflammation model in mice. This suggests that HSE has anti-inflammatory effects by inhibiting the TNF α and cyclooxygenase II (PGE2) pathways. Consequently, HSE could be a promising alternative to NSAIDs for managing inflammation, including in rheumatoid arthritis (RA), without the gastrointestinal side effects commonly associated with NSAIDs. Additionally, *H. cordata* extract (HCT) has been shown to efficiently inhibit the production of IL-6, IL-8, and TNF α (Park *et al.*, 2005; Lee *et al.*, 2013).

4.5 Haematological parameters

This study found that the treatment Groups (III, IV, V, and VI) showed a significant increase ($p<0.01$) in the RBC count and hemoglobin levels after the 14th day (the first day of treatment); on the other hand, the WBC and total platelet count significantly decreased compared to the normal group. The observed reduction in erythrocyte (RBC) and hemoglobin (Hb) levels in this study may be attributed to anemia, a diminished erythropoietin response from the bone marrow, and the early destruction of RBCs due to arthritis induced by CFA.

Similar findings were documented by Chen *et al*. (2020); Alzarea *et al*.(2022). Increase in the RBC and Hb level may be due to anti-inflammatory and antioxidant activities of *H. cordata* (Laldinsangi 2022; Rafiq *et al*., 2022). The protective action of *H. cordata* extract on RBC and Hb in treated groups of the present study may be due to presence of phytochemicals such as tannins and saponin that can stimulate the secretion of erythropoietin, a glycoprotein hormone that stimulates stem cells in the bone marrow to produce RBCs (Ufelle *et al.*, 2015). Increase in the WBC count in CFA treated rat groups indicates the leucocytosis in the joint region by infiltration of neutrophil cells. These findings were similar to findings of Glenn *et al.* (1965); Dhakad *et al*.(2018); Chen *et al.* (2020); Patel *et al*.(2021). Decrease in WBC following treatment with HEHC indicates its antioxidant and anti-inflammatory activities which are analogous to findings of Laldinsangi (2022); Rafiq *et al*. (2022). Increase in number of platelets in CFA treated groups indicates inflammatory pathogenesis in the joints. (Dhakad *et al*., 2018), while decrease in the platelet count indicates protective role by the extract and standard drug used. The CFA induced augmentation of platelet count in *H. cordata* leaf extract treated albino rat may be due to alkylation of functional groups in cellular proteins and restructuring of hematopoietic function which supports the present findings as per report of Kumar *et al.* (2016).

4.6 Biochemical parameters

The biochemical results of this study showed that HEHC treatment significantly reduced elevated liver enzymes (ALT, AST, ALP), kidney function markers (creatinine, BUN), and oxidative stress marker (MDA) levels. The treatment effects were comparable to the standard group, with higher doses of HEHC (300 and 900 mg/kg) showing more significant effects. The findings suggest that HEHC may have therapeutic potential in mitigating CFA-induced biochemical alterations.

Increased in the level of biochemical parameters such as ALT, AST, ALP and MDA are due to inflammation induced oxidative stress on administration of CFA (Tatiya *et al.*, 2017; Chen *et al*., 2020; Liu *et al*., 2022), while reduction in level of ALT, AST, ALP, MDA, BUN and creatinine in the *H. cordata* plant extract treated groups can be attributed to its antioxidant activity. Similar findings were reported by Kang and Koppula (2014); Laldisangi (2022); Pradhan *et al*. (2023). Increased level of BUN and creatinine were observed after CFA treatment because of inflammation induced oxidative stress as documented by Alzarea *et al*. (2022); Tatiya *et al.* (2017); Liu *et al*. (2022) and may be due to initiation of nephrotoxicity and parenchymal tissue injury of kidney (Gilbert *et al*., 1989). Reduction in level of creatinine and BUN in *H. cordata* plant extract treated groups may be because of the plant's diuretic and nephroprotective activity (Nakamura *et al*., 1938).

4.7 Histopathological observation

The histopathological results of the present study affirmed that HEHC treatment, particularly @ 300 mg/kg body weight and 900 mg/kg body weight exhibited better anti-inflammatory effect with very less or no inflammatory cell infiltration and restructured synovial membrane. Group treated with HEHC @ 900 mg/kg body weight showed superior result with restructured synovial membrane. This finding suggested a dose-dependent protective role of HEHC on tissue repair and remodelling in the damaged joint.

These findings were similar to reports made by Patil *et al*. (2012); Barua *et al*. (2017); Dhakad *et al*. (2018). Teng Li *et al*. (2022) examined the impact of *H. cordata* polysaccharide (HPC) on lipopolysaccharide-caused persistent vascular inflammation in rats. Histopathological examination revealed that HCP treatment alleviated vascular damage, reduced inflammation, and improved vascular structure in a dose-dependent manner. The results suggest that HCP may have therapeutic potential in mitigating vascular inflammation in rats and promoting vascular health.

5. Conclusion

The present study indicated that hydroethanolic leaves extract of *Houttuynia cordata* Thunb. have anti-inflammatory and anti-rheumatoid activity as evidenced from reduced hind paw volume, amelioration of body weight loss, haemato-biochemical parameters, bone and cartilage degradation. The antiarthritic activity is due to its anti- inflammatory and antioxidant properties which could be attributed to the rich phytochemicals present in the plant. Further study may be carried out in identifying the specific active principles responsible for assisting the present study.

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Conflict of interest

The authors declare no conflicts of interest relevant to this article.

References

Ahn, J.; Chae, H.S.; Chin, Y.W. and Kim, J. (2017). Alkaloids from aerial parts of *Houttuynia cordata* and their anti-inflammatory activity. Bioorganic Med. Chem. Lett., **27**:2807-2811.

Aletaha, D. and Smolen, J. S. (2018). Diagnosis and management of rheumatoid arthritis. JAMA., **320** (13):1360.

Alzarea, S. I.; Alasmari, A. F.; Alanazi, A. S.; Alzarea, A. I.; Alharbi, M.; Alshammari, A.; Kazmi, I.; Aljoufi, F. A.; Sayyed, N. and Afzal, M. (2022). Butin attenuates arthritis in complete freund's adjuvant treated arthritic rats:possibly mediated by its antioxidant and anti-inflammatory actions. Front. Pharmacol., **13**:1-10.

Barua, C. C.; Bodduluru, N. L.; Haloi, P.; Purukayastha, A.; Patowary, P.; Hussain, I. M. and Bora, M. (2017). Antiarthritic and anti-inflammatory activity of a polyherbal formulation against freund's complete adjuvant induced arthritis in Wistar rats. Ind. J. Trad. Know., **16**(3):482-489.

Bharate, S. B. (2003). Medicinal plants with anti-HIV potential. J. Med. Arom. P Sci., **25**(2):427-440.

Bullock, J.; Rizvi, S. A. A.; Saleh, A. M.; Ahmed, S. S.; Do, D. P.; Ansari, R. A. and Ahmed, J. (2018). Rheumatoid arthritis: A brief overview of the treatment. Int. J. Kuw. Univ., **27**(6):501-507.

Centre for Disease Control and Prevention. (2020). Retrieved from https://www.cdc.gov/arthritis/data_statistics /national-statistics.html

Chatterjee, J.; Mohan, P. and Dutta, M. (2020). Pharmacological evaluation of *xanthoxylum oxyphyllumedgew* extract with special reference to anti-inflammatory activity. Int. J. Curr. Micro. App. Sci., **9**(8):2330-2336.

Chen, G.; Song, Y.; Ma, F. and Ma, Y. (2020). Antiarthritic activity of D-carvone against complete freund's adjuvant induced arthritis in rats through modulation of inflammatory cytokines. Kor. J. Physio. Pharmacol., **24**(6):453-462.

Chen, J.; Wang, W.; Shi, C.; and Fang, J. (2014). A comparative study of sodium houttuyfonate and 2-undecanone for their i*n vitro* and i*n vivo* anti-inflammatory activities and stabilities. Int. J. Mol. Sci., **15**: 22978-22994. DOI:10.3390/ijms151222978

Chen, Y. Y.; Liu, J. F.; Chen, C. M.; Chao, P. Y. and Chang, T. J. (2003). A study of the antioxidative and antimutagenic effects of *Houttuynia cordata* Thunb. using an oxidized frying oil-fed model. J. Nutri. Sci. Vitaminol., **49**(5):327-333.

Chiang, L. C.; Chang, J. S.; Chen, C. C.; Ng, L. T. and Lin, C. C. (2003). Anti-herpes simplex virus activity of *Biden spilosa* and *Houttuynia cordata*. Ameri. J. Chi. Med., **31**(3):355-362.

Chun, F.W.; Cheuk, K.P.; Tsz, W.N.; Hok, H.P.; Eng, C.K.; Ki, F.T.; Yan, W.M.; Yuk, H.L.; Mui, F.H. and Chun, H.K. (2022). Anti-inflammatory, antipyretic efficacy and safety of inhaled *Houttuynia cordata* Thunb. essential oil formulation. J. Ethnopharmacol., **297:**115541. DOI: https://doi.org/10.1016/j.jep.2022.115541

Dhakad, P. K.; Sharma, P. K. and Kumar, S. (2018). Evaluation of antiarthritic activity of hydro alcoholic extract of *Capparis decidua* (Forssk.) edgew on freund's complete adjuvant induced arthritis in rats. Immunol. Inf. Dis., **6**(1):6-15.

Gilbert, D.N.; Wood C.A.; Kohlepp, S.J.; Houghton, D.C.; Finkbeiner, H.C.; Lindsley, J. and Bennett, W.M. (1989). Polyaspartic acid prevents experimental aminoglycoside nephrotoxicity. J. Infect. Dis., **159**:945-953.

Glenn, E. M.; Gray, J. and Kooyers, W. (1965). Chemical changes in adjuvant induced polyarthritis of rats. Am. J. Vet. Res., **26**(114):1195-1203.

Global RA Network, About Arthritis and RA. (2021). Retrieved from https://globalranetwork.org/project/disease-info/.

Han, A.; Robinson, V.; Judd, M.; Taixiang, W.; Wells, G. and Tugwell, P. (2004). Taichi for treating rheumatoid arthritis. Cochr. Data. Sys. Rev., **3**:1-26.

Harborne, J.B. (1998). Phytochemical methods: A guide to modern techniques of plant analysis. Analysis., 3rd Ed., Chapman and Hall, London, UK.

Hemalatha, S.; Kumar, M. and Prasad, S. (2014). A current update on the phytopharmacological aspects of *Houttuynia cordata* Thunb. Pharmacogn. Rev., **8**(15):22.

Kang, H. and Koppula, S. (2014). Hepatoprotective effect of *Houttuynia cordata* Thunb extract against carbon tetrachloride induced hepatic damage in mice. Indian Journal of Pharmaceutical Sciences., **76**(4):267-273.

Kim, G. S.; Kim, D. H.; Lim, J. J.; Lee, J. J.; Han, D. Y.; Lee, W. M.; Jung, W. C.; Min, W. G.; Won, C. G.; Rhee, M. H.; Lee, H. J. and Kim, S. (2008). Biological and antibacterial activities of the natural herb *Houttuynia cordata* water extract against the intracellular bacterial pathogen Salmonella within the RAW 264.7 macrophage. Biol. Pharma. Bull., **31**(11): 2012-2017.

Kumar, M.; Prasad, S. K. and Hemalatha, S. (2014). A current update on the phytopharmacological aspects of *Houttuynia cordata* Thunb. Pharmacogn. Rev., **8**(15):22-35.

Laldinsangi, C. (2022). The therapeutic potential of *Houttuynia cordata* :A current review. Heliyon., **8**(8):1-10.

Laloo, D. and Hemalatha, S. (2011). Ethnomedicinal plants used for diarrhea by tribals of Meghalaya, Northeast India. Pharmacogn. Rev., **5**(10):147-154.

Lau, K. M.; Lee, K. M.; Koon, C. M.; Cheung, C. S.; Lau, C. P.; Ho, H. M.; Lee, M. Y.; Au, S. W.; Cheng, C. H.; Lau, C. B.; Tsui, S. K.; Wan, D. C.; Waye, M. M.; Wong, K. B.; Wong, C. K.; Lam, C. W.; Leung, P. C. and Fung, K. P. (2008). Immunomodulatory and anti-SARS activities of *Houttuynia cordata*. J. Ethnopharmacol., **118**(1):79-85.

Lee, H.J.; Seo, H.S.; Kim, G.J.; Jeon. C.Y.; Park, J.H.; Jang, B.H.; Park, S.J.; Shin, Y.C. and Ko, S.G. (2013). *Houttuynia cordata* Thunb. inhibits the production of pro-inflammatory cytokines through inhibition of the NFκB signaling pathway in HMC-1 human mast cells. Mol. Med. Rep., **8**(3):731-736.

Li, J. and Zhao, F. (2015). Anti-inflammatory functions of *Houttuynia cordata* Thunb and its compounds: A perspective on its potential role in rheumatoid arthritis. Exp. Therap. Med., **10**(1):3-6. DOI:10.3892/etm.2015.2467

Li, J.; Zhou, T. and Zhao, F. (2014). Inhibitory effect of sodium houttuyfonate on synovial proliferation *in vitro* in cells from a patient with rheumatoid arthritis. Exp. Ther. Med., **7**:1639-1642. DOI:10.3892/etm.2014.1636

Li, W. Zhou.; Zhang, P. Y. and He, L. (2011). *Houttuynia cordata*, a novel and selective COX 2 inhibitor with anti inflammatory activity. J Ethnopharmacol., **133**:922 927.

Li, W.; Fan, T.; Zhang, Y.; Fan, T.; Zhou, P. and Niu, X. (2013). *Houttuynia cordata* Thunb. volatile oil exhibited anti-inflammatory effects *in vivo* and inhibited nitric oxide and tumor necrosis factor-á (TNF- á) production in LPS stimulated mouse peritoneal macrophages *in vitro*. Phytother. Res., **27:**1629-1639. DOI:10.1002/ptr.4905

Liu, C.; Li, Y.; Wen, C.; Yan, Z.; Olatunji, O. J. and Yin, Z. (2022). Dehydrozingerone alleviates hyperglycemia, oxidative stress and inflammatory factors in complete freund's adjuvant induced arthritic rats. Drug Design. Dev. Therapy., **16**:3015-3022.

Lu, H. M.; Liang, Y. Z.; Yi, L. Z. and Wu, X. J. (2006). Anti-inflammatory effect of *Houttuynia cordata* injection. J. Ethnopharmacol., **104**(1-2):245-249.

Ma, Q.; Wei, R.; Wang, Z.; Liu, W.; Sang, Z.; Li, Y. and Huang, H. (2017). Bioactive alkaloids from the aerial Parts of *Houttuynia cordata*. J. Ethnopharmacol., **195**:166-172.

Mallmann, R.; Ethur, E. M.; Bianchetti, P.; Faleiro, D.; Hoehne, L. and Goettert, M. I. (2018). Effectiveness of aqueous and hydroalcoholic extracts of *Acanthospermum australe* (Loefl.) Kuntze against diarrhea-inducing bacteria. Braz. J. Biol., **78**(4):619-624.

McInnes, I. B. and Schett, G. (2011). The pathogenesis of rheumatoid arthritis. N. Engl. J. Med., **365**:2205-2219.

McInnes, I. B. and Schett, G. (2017). Pathogenetic insights from the treatment of rheumatoid arthritis. Lancet., **389**:2328-2337.

Meng, J.; Zong, X. and Dong, X. (2008). Study on pharmacological effects of fresh and dry *Houttuynia cordata* Thunb. Lishizhen. Med. Mat. Medic. Res., **19**(6):1315-1316.

Nakamura, H.; Ota, T. and Fukuchi, G. (1938). The constituents of diuretic drugs II: The flavonol glucoside of *Houttuynia cordata* Thunb. J. Pharma. Society Japan, **56**(3):68.

Pan, T.; Cheng, T.; Jia, Y.; Li, P. and Li, F. (2017). Anti-rheumatoid arthritis effects of traditional Chinese herb couple in adjuvant induced arthritis in rats. J. Ethnopharmacol., **205**:1-7

Park, E.; Kum, S.; Wang, C.; Park, S.Y.; Kim, B.S. and Schuller Levis, G. (2005). Anti inflammatory activity of herbal medicines: inhibition of nitric oxide production and tumor necrosis factor alpha secretion in an activated macrophage like cell line. Am. J. Chin. Med., **33**:415 424.

Patel, R.; Kadri, S.; Gohil, P.; Deshpande, S. and Shah, G. (2021). Amelioration of complete freund's adjuvant-induced arthritis by *Calotropis procera* latex in rats. Future J. Pharma. Sci., **7**:1-11.

Patil, M. V.; K. Kandhare. and Bhise, S. D. (2012). Antiarthritic and anti-inflammatory activity of *Xanthium srtumarium* L. ethanolic extract in freund's complete adjuvant induced arthritis. Biomedicine and Ageing Patholog., **2**(1):6-15.

Pradhan, S.; Rituparna, S.; Dehury, H.; Dhall, M. and Singh, Y. D. (2023). Nutritional profile and pharmacological aspect of *Houttuynia cordata* Thunb. and their therapeutic applications. Pharma. Res. Mod. Chines. Med., **9**:1-17.

Rafiq, S.; Hao, H.; Ijaz, M. and Raza, A. (2022). Pharmacological effects of *Houttuynia cordata* Thunb (*H. cordata*): A comprehensive review. Pharmaceuticals., **15**, 1079. https://doi.org/10.3390/ph15091079.

Rathi, R. S.; Roy, S.; Anuo, K.; Misra; and Singh, S. K. (2014). Ethnobotanical notes on *Houttuynia cordata*Thunb. in North-eastern region of India. Ind. J. Nat. Prod. Res., **4**(4):432-435.

Rossini, M.; Rossi, E.; Bernardi, D.; Viapiana, O.; Gatti, D.; Idolazzi, L.; Caimmi, C.; Derosa, M. and Adami, S. (2014). Prevalence and incidence of rheumatoid arthritis in Italy. Rheumato. Int., **34**(5):659-664.

Sakuludomkan, W.; Yeewa, R.; Subhawa, S.; Khanaree, C.; Bonness, A.I. and Chewonarin, T. (2021). Effects of fermented *Houttuynia cordata* Thunb. on diabetic rats induced by a high fat diet with streptozotocin and on insulin resistance in 3T3-L1 adipocytes. J. Nutri. Metab., **6**:6936025. https://doi.org/10.1155/2021/6936025.

Senthelal, S.; Li, J.; Ardeshirzadeh, S. and Thomas, M. A. (2023). Arthritis (Treasure Island). Stat Pearls Publishing., https:// www.ncbi.nlm.nih.gov/books/NBK518992.

Shin, S.; Joo, S.S. and Jeon, J.H. (2010). Anti-inflammatory effects of a *Houttuynia cordata* supercritical extract. J Vet Sci., **11**:273 275.

Shingnaisui, K.; Dey, T.; Manna, P. and Kalita, J. (2018). Therapeutic potentials of *Houttuynia cordata* Thunb. against inflammation and oxidative stress: A review. J. Ethnopharmacol., **220**:35-43.

Tatiya, A.U.; Saluja, A.K.; Kalaskar, M.G.; Surana, S.J. and Patil, P. H. (2017). Evaluation of analgesic and anti-inflammatory activity of *Brideliaretusa* (Spreng) bark. J. Trad. Complement. Med., **7**(4):441-451.

Team, S.; Team, S. and Singlecare. (2024). Arthritis statistics (The Checkup)., https://www.singlecare.com/blog/news/arthritis.

Teng, L.; Ting, S.; Ye-Hao, S.; Xun-Jiao, H.; Qiong, W.; Yu-Fei, Y. and Wen-Juan, L. (2022). *Houttuynia cordata* polysaccharide alleviates chronic vascular inflammation by suppressing calcium-sensing receptor in rats. J. Functional Foods, **95**:105172.

Ufelle, S.; Neboh, E. and Ghasi, S. (2015). Potential haematopoietic properties of crude methanolic seed extract of *Pentaclethra macrophylla* in Wistar rats. Biokemistry, **27**(27):22-25.

Vent, W.; Duke, J. A. and Ayensu, E. S. (1987). Medicinal plants of China. Feddes Repertorium., **98**(7-8):398-398.

Woranam, K.; Senawong, G.; Utaiwat, S.; Yunchalard, S.; Sattayasal, J. and Senawong, T. (2020). Anti-inflammatory of the dietary supplement *Houttuynia cordata* fermentation product in RAW 264.7 cells and Wistar rats. Plos. One., **15**(3):1-18.

Wu, Z.; Deng, X.; Hu, Q.; Xiao, X.; Jiang, J.; Ma, X. and Wu, M. (2021). *Houttuynia cordata* Thunb.: An ethnopharmacological review. Front. Pharmacol., **12**:1-16.

Yadav, A. K. and Temjenmongla (2011). Anticestodal activity of *Houttuynia cordata* leaf extract against *Hymenolepis diminuta* in experimentally infected rats. J. Para. Dis., **35**(2):190-194.

Yang, W.; Chen, X.; Li, Y.; Guo, S.; Wang, Z. and Yu, X. (2020). Advances in pharmacological activities of terpenoids. Nat. Prod. Communi., **15**(3):1-13.

Yang, X. Y.; Shi, T.; Du, G.; Liu, W.; Yin, X. F.; Sun, X.; Pan, Y. and He, Q. Y. (2016). iTRAQ-based proteomics revealed the bactericidal mechanism of sodium new houttuyfonate against *Streptococcus pneumoniae*. J. Agri. Food Chem., **64**(32):6375-6382.

Zhang, J.; Wu, X.; Luo, Z. and Zhong, X. (2007). Determination of chemical components and antibacterial activities of *Houttuynia cordata* Thunb. during desiccation and storage. Food Sci., **28**(11):565-569.

Zhang, L.; Lv, H.; Li, Y.; Dong, N.; Bi, C.; Shan, A.; Wu, Z. and Shi, B. (2020). Sodium houttuyfonate enhances the intestinal barrier and attenuates inflammation induced by *Salmonella typhimurium* through the NF-κB pathway in mice. Int. Immunopharmacol., **89**(Pt A):1-11.

Zhu, H.; Lu, X.; Ling, L.; Li, H.; Ou, Y.; Shi, X.; Lu, Y.; Zhang, Y. and Chen, D. (2018). *Houttuynia cordata* polysaccharides ameliorate pneumonia severity and intestinal injury in mice with influenza virus infection. J. Ethnopharmacol., **218**:90-99.

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