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Research Article

Pharmacological evaluation of analgesic, anti-pyretic and anti-inflammatory activities of ethanolic root extract of *Amaranthus caudatus*

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Abstract

Background: *Amaranthus caudatus* Linn, belonging to a family Amaranthaceae. *Amaranthus caudatus* is found in South America, India, or Indo-Chinese district, Mexico, and the Mediterranean area. *Amaranthus caudatus* contains different kinds of substance constituents which are responsible for its therapeutic potential. *Amaranthus caudatus* is usually utilized in the treatment of jaundice, amoebiasis, and kidney ailment, as a blood purifier, diuretic, abortifacient, vermifuge, astringents, and for liver illness. The research work deals with the screening of the analgesic, antipyretic and anti-inflammatory activities of ethanolic root extract of *Amaranthus caudatus.* For this, the alcoholic extract of the selected plant was used for analgesic activity, anti-inflammatory activity and anti-pyretic activities.

The result: In current investigation, diclofenac sodium (10mg/kg, p.o.) was used as a standard drug. The effects of ethanolic root extract (200 and 400mg/kg, p.o.) of *Amaranthus caudatus* on Wistar albino rats for the assessment of analgesic, anti-inflammatory as well as antipyretic activities. The current research revealed that EEAC (200 and 400mg/kg,p.o.) possessed significant ($P<0.05$) analgesic, anti-inflammatory and antipyretics activities in a dose-dependent manner. Furthermore EEAC (200 and 400mg/kg p.o) were effective as standard drug (Diclofenac sodium 10mg/kg, p.o). All these methods were performed under highly supervised conditions and by proper handling of experimental animals having been granted permission by IAEC.

The conclusion: In the present study, it was concluded that the EEAC was effective in a dose-dependent manner and possessed potent analgesic, anti-inflammatory and antipyretic activities.

Keywords: *Amaranthus caudatus*, Analgesic, Anti-pyretic, Anti-inflammatory, Diclofenac sodium, Phytochemical screening.

INTRODUCTION

There are several kinds of sicknesses, infirmity, and issues within our body, along with them; pain and inflammation are the most noticeably awful sort of inconvenience conditions[1]. Pain is the most ordinarily distressed tactile and enthusiastic experience which is related to intense potential tissue harm during any stimuli[2]. Pain is the most widely recognized explanation for individuals' search the clinical consideration[3]. Pain is brought about by the bothering of the pain receptors, called nociceptors[4]. Analgesics are the medications that are utilized to reduce diverse types of pain. The pain-relieving agent works through pain receptors (*Mu, Kappa, and Delta*)[5]. Inflammation might be characterized as the typical, defensive reaction to tissue injury in the body that is brought about by physical injury and any hurtful synthetic compounds or microbiological agents which harmed the cell and tissues[6]. For the most part, the process of inflammation is related to the enactment and contribution of emission of cytokines, for example, TNF-α, IL-6 and IL1 β, by activated cells which play a major role in host defense mechanisms[7]. The clinical treatment of inflammatory infections relies upon drugs that have a place either with the non-steroidal or steroidal synthetic therapeutics yet once in a while these medications have genuine symptoms when utilized on long occasions[8]. Pyrexia or fever is caused because of contamination, tissue harm, irritation, joint dismissal, threat, or because of pathogenic diseases, for example, microscopic organisms or infections set off the body's protection systems[9]. Fever is caused as an auxiliary effect of contamination, threat, or other infected states[10].

Amaranthus caudatus Linn, (Amaranthaceae), are spread all through the world. *Amaranthus caudatus* becoming below a broad scope of climatic circumstances in addition to they can deliver grains and verdant consumable vegetables[11]. Amaranth is found in South America, India, or Indo-Chinese district, Mexico, and the Mediterranean area. *Amaranthus caudatus* has a place in the family Amaranthaceae[12]. *Amaranthus caudatus* contains different kinds of substance constituents, for example; caffeic acid, gallic acid, ferulic acid, rutin and quercetin[13]. *Amaranthus caudatus* contains antimicrobial peptides, agglutinin, triterpinoids, saponin, and control inferred glycoside, protein, amino corrosive, nutrient E isomers, amaranthine, and flavonoids[14]. *Amaranthus caudatus* is customarily utilized in the treatment of Jaundice, Amoebiasis, and Kidney ailment[15]. Additionally as a blood purifier, diuretic, abortifacient, vermifuge, Astringents, and for liver illness[16]. The current examination is planned to research

the conceivable pain-relieving, mitigating and antipyretic in root concentrates of *Amaranthus caudatus.*

MATERIAL AND METHODS:

Selection, identification and authentication of plant material

The plant material (roots) of *Amaranthus caudatus* had been chosen to commence self-cultivation in the area of Moradabad (U.P.), India in addition to taxonomically identified and authenticated by a qualified botanist. Plant authentication was done by a team of botanists under the supervision of Dr. Ashok Kumar (Head of Botany Department), IFTM University, Moradabad (U.P) India.

Extraction of plant material

The dried-up root material was crushed furthermore passed throughout a 20-mesh sieve. The coarse powder of the root of *Amaranthus caudatus* 500gm was packed in a Soxhlet apparatus. The root material was defatted utilizing 1-liter petroleum ether (60-80), and afterward extracted with 1-liter ethanol (95%, v/v) intended for 72 hrs. The extract was filtered in addition to concentrated by distilling off and evaporated below reduced pressure to get a semisolid mass along with then vacuum dried to give up solid residues. The dried extract was stored within an airtight vessel waiting the time of utilization. The weight of ethanolic plant root extract was found to be 15.1g.

Drugs and chemicals

The necessary chemicals utilized during this research work have been carrageenan (S.D fine Chemicals Limited, Bombay), acetic acid (S.D fine Chemicals Limited, Bombay) and Voltaren (diclofenac sodium; Biochem; Pharma, Mumbai)Biochem Pharma, Mumbai) was used as standard drugs.

Equipment

Eddy's hot-plate, Thermometer, Digital Balance, Desiccator, Hot Air oven.

Experimental animals

Wistar albino rats of any sex (150-250gm) have been utilized intended for this research work.

Phytochemical Screening

A preliminary photochemical examination was done for ethanolic extract. The presence of carbohydrates was determined by Molish test, Benedict and Fehling's test; Tannins and Phenol compound by gelatin test, ferric chloride test; Flavonoids by Sinodha, ferric chloride test, lead acetate test, alkaline reagent test; Triterpinoids by Salkowski's test, Libermann test; Saponin by foam as well as hemolysis test; Protein and Amino acid by Millon's and Ninhydrin tests[17].

Toxicity Study

Amaranthus caudatus was tested in double dose within every experimental method according to the OECD guideline no. 420 fixed-dose method procedure; the safest dose of ethanolic extract was 2000mg/kg, p.o. body weight. For the assessment of analgesic, antipyretic as well as anti-inflammatory activities, dose level was selected in such a manner that, the dose was just about one-tenth one (low dose; 200mg/kg, p.o) along with one-fifth (high dose; 400mg/kg,p.o) of the maximum dose throughout acute oral toxicity study (2000mg/kg/day, p.o.). Diclofenac sodium (10mg/kg/oral) had been utilized as the reference drug[18].

EXPERIMENTAL DESIGN:

Assessment of analgesic activity

Acetic acid-induced writhing test

The experimental animals have been separated into 4 groups. Each group contains six animals. The animals of group I received 0.5% carboy methyl cellulose (10ml/kg,p.o.), the animals of group II received diclofenac sodium (10mg/kg,p.o), animals of the group III received EEAC (200mg/kg,p.o); the animals of group IV received EEAC (400mg/kg,p.o.). The writhing test for the analgesic activity was performed as carried out by Koster[19]. Following 30 minutes of treatment, every animal of every group was treated intraperitoneally by way of 0.6% acidic acid in normal saline at the dose of 0.6% 10ml/kg/p.o. The animals had been pragmatic in addition to note for the number of abdominal contractions as well as stretching within 0-20 minutes. A decrease in the numbers of writhing's contrasted with the animals of control group that was investigated for pain that was shown while % as reduction of writhings.

Eddy's hot-plate test

The hot-plate method was utilized to assess the thermal pain reflexes because of footpad contact with a warmed surface. The selected animals were separated into 6 groups in addition every group contained 6 selected animals. The selected animals were lying on the hot-plate at a stable temperature of 55^0C as well as response time (in second). The jumping of paw responses of each animal was noted. The above procedure was repetitive at 30, 60, 90 and 120-minute time gaps. The animals were allowed only 15 seconds to keep away from injury to the paws[20].

Tail-flick method

Before the analgesic activity, the animals have been checked meant for a sense assessment via dipping the tilt of the tail (5cm) lightly within warm water (55^0C). In only some seconds, the animals take action by pulling back their tail from the hot water. The response period is noted by using a stopwatch. The response time was accessed following the administration of the drug's substance. The dispose of a period of tail immersion turned into in use 15 seconds[21].

Assessment of anti-inflammatory activity

Carrageenan-induced paw edema in rats

The selected animals were separated into 4 groups. Every group contains 6 animals. Group I animals administered 0.5% CMC (10ml/kg,p.o.); Group II animals administered diclofenac sodium (10mg/kg,p.o.); Group III animals administered EEAC (200mg/kg,p.o.); Group IV animals administered EEAC (400mg/kg,p.o.). This technique was preceded as recently portrayed by Winter[22]. After 60 minutes, of the test and standard medications, every animal in every group was subcutaneously injected carrageenan 0.1 ml (1%w/v) in normal saline solution at the location of sub-plantar area of the right hind paw. The level of the right hind paw was expected at 1, 2, as well as 3 hrs following injection of carrageenan; furthermore, the swelling degree has been recorded. The information was shown as a percentage of swelling in contrast with the preliminary hind paw volume of every animal.

Assessment of the antipyretic activity

Yeast-induced pyrexia in rat

The test animals were separated into 4 groups. Every group contains 6 animals. The Yeast-induced pyrexia test has been utilized for the assessment of the test drug. The health temperature of every animal was checked using noted the rectal temperature at a prearranged point in time gaps. Pyrexia was produced through inject the brewer's yeast (15%

suspension)) using an ordinary method. A thermister was inserted 3-4cm profound into the rectal and recorded the rectal temperature. The selected animals get received injection of brewer's yeast (10ml/kg, s.c.) suspension prepared in 0.5% w/v CMC solution. 19 hrs following yeast injection, the animals were once more reserved within an individual case to check their rectal temperature. Rapidly the test and the standard drug were given orally according to their doses[23].

Statistical analysis

Every one of the values have been expressed as Mean ±S.E.M the result consequence had been analyzed statistically via one-way ANOVA followed via Dunnett's multiple tests, P<0.05 was well thought-out significant as soon as compared by means of the control group.

RESULTS

Phytochemical screening

Phytochemical screening of the ethanolic root extract of Amaranthus caudatus represented the presence of carbohydrates, tannins, flavonoids, saponin, phenolic compounds, proteins, amino acids, tri-terpenoids, and glycosides as the results.

Acute toxicity Study

Amaranthus caudatus root extract did not turn out any death still next to the dose of 2000mg/kg,p.o. After checking out the toxicity study, the two doses (200 and 400mg/kg,p.o) of *Amaranthus caudatus* was chosen in favor of additional pharmacological studies.

Assessment of analgesic activity for EEAC

Acetic acid-induced writhing test

Effects of EEAC in acetic acid-induced writhing test

The action of EEAC (200 and 400mg/kg,p.o.) in addition to diclofenac sodium is described in table 1. The diclofenac sodium (10mg/kg,p.o.) has a high significantly decreased number of writhings, whereas EEAC (400mg/kg,p.o.) represents moderately significant effects as well as decreased the number of writhings. EEAC (200mg/kg, p.o.) was non-significantly effective when contrasted with the control group.

Table 1: Effect of EEAC on writhings test

Treatment group	Dose (mg/kg,p.o.)	Total no of writhings.	% inhibition%
Control (CMC).	10ml/kg	47.67±2.89	0
Diclofenac sodium	10	14.17±1.22***	71.68
EEAC	200	47.67±0.88^{ns}	4.68
EEAC	400	37.17±1.27**	25.68

All the values have been expressed as Mean ±S.E.M, test employed one-way ANOVA by Dennett's test (n=6); significantly different from the control at *(P<0.05), **(P<0.01), ***(P<0.001) and ns (non-significant) when compared to the control group.

Hot-plate test

Effect of EEAC in the hot-plate test

An outcome represents that the diclofenac sodium (10mg/kg,p.o) highly significantly enhanced the response time within rats at all the periods gapes considered 30, 60, 90, and 120 minutes. EEAC (200mg/kg,p.o.) created non- significantly effects at the different times measured. The EEAC (400mg/kg,p.o) significantly response time after 30 and 120 minutes of administration of drug whereas represented non-significant reaction at various time gape is 60 and 90 minutes. EEAC produced a significant outcome when contrasted with the control group as the outcomes have been represented in table 2.

Table 2: Effects of EEAC on the hot-plate test

Treatment Group	Dose	Initial basal Reaction Time (Sec).	Reaction Time (sec).			
			30min	60min	90min	120min.
Control (CMC)	10ml/kg,p.o.	3.34±0.33	4.33±0.21	5.16±0.30	5.50±0.42	5.50±0.56
Diclofenac sodium	10mg/kg,p.o.	3.66±0.33^{ns}	11.66±0.83***	11.83±0.83***	12.66±0.42***	12.33±0.71***
EEAC	200mg/kg p.o.	4.33±0.21^{ns}	4.66±0.84^{ns}	5.00±0.63^{ns}	5.16±0.70^{ns}	5.16±0.65^{ns}
EEAC	400mg/kg,p.o.	4.66±0.33^{ns}	7.16±0.87*	7.50±0.76^{ns}	7.66±1.40^{ns}	8.50±0.99*

All the values have been expressed as Mean ±S.E.M, test employed one-way ANOVA by Dennett's test (n=6); significantly different from the control at *(P<0.05), **(P<0.01), ***(P<0.001) and ns (non-significant) when compared to the control group.

Tail-flick test

Effects of EEAC on tail-flick method

The standard drug diclofenac sodium (10mg/kg,p.o.) produced a highly significant effect and increased the nociceptive reaction time after 30, 60, 90 and 120 minutes of drug administration. EEAC (200mg/kg, p.o.) produced non-significant effect after 30, 60, 90 and 120 minutes. While the EEAC (400mg/kg,p.o.) represents a highly significant effect after 60 minutes whereas significant effects after 30 minutes and 120 minutes of drug administration effects while contrasted with the control group as the outcomes represented in table 3.

Table 3: Effects of EEAC on tail-flick method

Treatment Group	Dose	Response time in (sec) after drug administration.				
		0min.	30min.	60min.	90min.	120min
Control (CMC)	10ml/kg,p.o.	3.60±0.22	4.15±0.18	4.26±0.35	4.27±0.31	3.98±0.17
Diclofenac sodium.	10mg/kg,p.o.	4.22±0.17^{ns}	6.29±0.18***	7.84±0.49***	9.07±0.46***	8.10±0.38***
EEAC	200mg/kg,p.o.	4.59±0.26^{ns}	6.07±0.24^{ns}	5.29±0.65^{ns}	6.26±0.24^{ns}	5.92±0.35^{ns}
EEAC	400mg/kg,p.o.	3.86±0.72^{ns}	6.80±0.49*	6.99±0.53***	7.44±0.33^{ns}	6.54±0.50*

All the values have been expressed as Mean ±S.E.M, test employed one-way ANOVA by Dennett's test (n=6); significantly different from the control at *(P<0.05), ** (P<0.01), ***(P<0.001) and ns (non-significant) when compared to the control group.

Assessment of anti-inflammatory activity for EEAC

Carrageenan-induced paw edema test

Effect of EEAC on carrageenan-induced paw edema

The anti-inflammatory effects of EEAC, as well as diclofenac sodium on carrageenan-induced hind paw edema test, has been revealed in Tables 4 and 5. The diclofenac sodium (10mg/kg,p.o.) exert more significant effects against carrageenan-induced inflammation after 2 hrs and 3 hrs of administration. The dose of diclofenac sodium (10mg/kg,p.o.) exhibited a more significant reduction of 80.28% after 2 hrs, the effect increased at 3 hrs which is 85.43%. The EEAC (200mg/kg, p.o.) exhibited highly significant inhibition of 66.66 % after 2 hrs; the effect increased at 3 hrs is 76.14 %. The EEAC (400mg/kg, p.o.) exhibited highly significant inhibition of 67.24 % after 2 hrs, the effect increased at 3 hrs that is 74.91 %, while contrasted with the control group as the outcomes represented in table 4.

Table 4: Effect of EEAC on Carrageenan-induced paw edema test

S. No.	Treatment Group	Dose (mg/kg,p.o.)	Paw volume in (ml) at hr.			
			Initial volume	1 hr	2 hrs	3hrs
1.	Control (CMC)	10 ml/kg	2.76±1.18	1.90±041	3.45±0.39	5.70±0.82
2.	Diclofenac Sodium	10 mg/kg	0.36±0.03	0.55±0.04***	0.68±0.03***	0.83±0.03***
3.	EEAC	200 mg/kg	0.50±0.06	1.15±0.04^{ns}	1.15±0.04***	1.36±0.04***
4.	EEAC	400 mg/kg	0.35±0.02	0.55±0.02*	1.13±0.03***	1.43±0.02***

Table 5: % inhibition for the effect of EEAC on carrageenan-induced paw edema test

Treatment group	Dose (mg/kg)/ml/kg,p.o.	% inhibition		
		1 hr	2hrs	3 hrs
Control (CMC)	10 ml/kg	_	_	_
Diclofenac sodium	10	71.05	80.28	85.43
EEAC	200	39.74	66.66	76.14
EEAC	400	71.05	67.24	74.91

All the values have been expressed as Mean ±S.E.M, test employed one-way ANOVA by Dennett's test (n=6); significantly different from the control at *(P<0.05), **(P<0.01), ***(P<0.001) and ns (non-significant) when compared to the control group.

Assessment of antipyretic activity EEAC

Brewer's yeast-induced pyrexia test

Effect of EEAC on Brewer's yeast-induced pyrexia test

In the current test, EEAC (200mg/kg,p.o.) exerts a significant effect following 1 hr, and 2 hr administration whereas after 3 hrs and 4 hrs produced moderate and more significant effects respectively. EEAC (400mg/kg,p.o.) produced moderate significant effects after 1 hr whereas highly significantly after 2 hrs, 3 hrs, and 4 hrs of drug administration. The reference diclofenac sodium (10mg/kg,p.o.) showed a highly significant outcome while contrasted with the control group as the outcomes represented in table 6.

Table 6: Effect of EEAC on Brewer's yeast-induced pyrexia test

Treatment Group	Dose (mg/kg or ml/kg,p.o)	Initial Temp. (^{0}C).	Temp. after 19 hrs of yeast admin.	Rectal temperature after yeast admin.			
				1 hr	2hrs	3 hrs	4 hrs
Control (CMC)	10 ml/kg	37.08± 0.26	39.15± 0.13	39.16± 0.21	39.03± 0.41	39.23± 0.23	39.68±0.07
Diclofenac sodium	10	37.11±0.18	38.25±0.35**	37.86±0.24**	37.53±0.20***	37.46±0.19***	37.31±0.16***
EEAC	200	37.18±0.13	37.98±0.33*	38.18±0.25*	37.90±0.30*	37.83±0.23**	37.83±0.27***
EEAC	400	37.06±0.27	38.63±0.33^{ns}	37.98±0.16**	37.61±0.36***	37.35±0.19***	37.73±0.18***

All the values have been expressed as Mean ±S.E.M, test employed one-way ANOVA by Dennett's test (n=6); significantly different from the control at *(P<0.05), **(P<0.01), ***(P<0.001) and ns (non-significant) when compared to the control group.

DISCUSSION

The anti-nociceptive effect of ethanolic extract of *Amaranthus caudatus* had been evaluated utilizing the three models (Acetic-acid induced writhings test, hot-plate test and tail-flick test). The acetic acid induced writhings method turned into generally utilized to assess the peripheral analgesic action of any drugs as well as other chemicals for its potential[24]. The EEAC extensively decreased the acetic acid induced writhings within animals. The EEAC (200mg/kg, p.o) produced non-significantly action and exhibited only 4.68% inhibition of writhing in animals, whereas EEAC (400 mg/kg) produced significant effects and also exhibited a 25.68% reduction of writhing inside tested rats. In the nearby examination, the reference drug diclofenac sodium (10mg/kg, p.o) exerts a highly significantly decreased in the number of writhings furthermore also exhibited 71.68% inhibition in writhing in animals.

In the hot-plate, the extract of the plant (EEAC), as well as diclofenac sodium (10mg/kg, p.o.), moreover exists a longer latency moment in time than the control group inside the hot-plate test within a dose in a dose-dependent manner. The EEAC (200mg/kg, p.o) exert a non-significantly effect at 0, 30, 60, 90 as well as 120 minutes of the time gape. While EEAC (400mg/kg, p.o) produced a moderately significant effect at 120 minutes after drug administration. Therefore, the ethanolic extract of the plant may possess peripherally and centrally actions. Once more, narcotic analgesics reduce mutually secondary as well as a central way of pain, whereas non-steroidal anti-inflammatory drugs reduce single peripheral pain[25, 26].

The ethanolic extract of *Amaranthus caudatus* (EEAC) turned into an additional assessment within the tail immersion method meant for its pain effects. The tail immersion technique is the kind of thermal stimuli that produces centrally mediated analgesia next to the supraspinal stage. This technique is supraspinally mediated and has selectivity intended for centrally acting analgesics.

Inside the tail immersion test, ethanolic extract of *Amaranthus caudatus* (EEAC) exhibited a significant increase in reaction time to thermal stimuli showing pain effects. EEAC (200mg/kg,p.o) exhibits moderately significant effects following 30, 90 and 120 minutes but a non-significant effect after 60 min. EEAC (400mg/kg,p.o) exhibit highly significant effects following 30, 60, 90 and 120 minutes of intervals. In comparison, diclofenac sodium also produced highly significant effects. In this method, a rise in the reaction time is well thought-out for evaluating central anti-nociceptive activities activity[27]."The best and broadly utilized method for assessing anti-inflammatory substance is carrageenan-induced hind paw edema. Carrageenan-induced hind paw edema is a biphasic reaction. The main stage is intervened all the way arrival of histamine, serotonin as well as kinins during the first hour. The subsequent stage is identified with the arrival of prostaglandins[28, 29].In this method, the reference drug diclofenac sodium (10mg/kg, p.o) exhibited highly significant effects in opposition to carrageenan-induced inflammation after 2 hrs and 3 hrs of administration. The dose of diclofenac sodium (10mg/kg) exhibited highly significant inhibition of 80.28% after 2 hrs, the effect increased at 3 hrs which is 85.43%. The EEAC (200mg/kg, p.o.) exhibited highly significant inhibition of 66.66 % after 2 hrs, the effect increased at 3 hrs which is 76.14 %. The EEAC (400mg/kg, p.o.) exhibited highly significant inhibition of 67.24 % after 2 hrs, the effect increased at 3 hrs which is 74.91 %. The extract EEAC showed a significant reduction of inflammation in both phase-in dose-dependent manners. The outcome produced from the carrageenan-induced paw edema analysis used within the nearby work revealed that the EEAC test drugs possess anti-inflammatory action. The present finding of the research work indicated that EEAC may be peripherally acting.

Yeast-induced fever is called pathogenic fever. An endogenous pyrogenic enacts IL-1 and prostaglandins, mostly PGE2 which changes digestion of thermoregulatory cells using cAMP optional courier intervened component. This outcome is an expansion set point for thermo guidelines to an elevated temperature. Thus, restraint of prostaglandin union could be the conceivable component of the antipyretic activity[30, 31].

In yeast-induced pyrexia, EEAC (200mg/kg, p.o) exhibits significant effects following 1, 2 hrs administrations and after 3 hrs whereas 4 hrs produced moderate and more significant effects respectively. EEAC (400 mg/kg, p.o.) produced moderate significant effects after 1 hr whereas more significantly after 2 hr, 3 hrs, and 4 hrs of drug administration. The EEAC (200 and 400mg/kg, p.o.) in addition to diclofenac sodium (10mg/kg, p.o.) reduced the rectal temperature at a dissimilar time gapes that following 1, 2 hr and 4 hrs of the test drug substance administration. The standard drug diclofenac sodium (10mg/kg, p.o) exhibits a highly significant outcome while contrasting with that of the control group.

CONCLUSION

The effects of ethanolic root extract (200 and 400mg/kg, p.o.) of *Amaranthus caudatus* on Wistar albino rats for the assessment of analgesic, anti-inflammatory as well as antipyretic activities. The current research revealed that EEAC (200 and 400mg/kg,p.o.) possessed significant (P<0.05) analgesic, anti-inflammatory and antipyretics activities in a dose-dependent manner. Furthermore EEAC (200 and 400mg/kg p.o) were effective as standard drug (Diclofenac sodium 10mg/kg, p.o). All these methods were performed under highly supervised conditions and by proper handling of

experimental animals having been granted permission by IAEC. This study will be supportive in the future for the improvement of a novel herbal formulation for the diagnosis and treatment of related complications.

CONFLICT OF INTEREST

The authors have no conflict of interest regarding this research work.

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