PharmacologyOnLine
August 30, 2012
Archives • 2012 • vol.2 • 52 - 58

ANTI-INFLAMMATORY AND ANTI-NOCICEPTIVE ACTIVITY OF *Aerva tomentosa* LINN. (AMARANTHACEAE)

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Abstract

Aerva tomentosa Linn. (Amaranthaceae) is a rigid perennial much branched shrub, found as weed throughout India. The ethanolic extract of the aerial parts of *Aerva tomentosa* (EEAT) at 100, 200 and 400mg/kg/p.o was screened in rats for anti-inflammatory activity by acute-carrageenan induced paw edema, sub-acute cotton pellet induced granuloma and chronic Freund's adjuvant induced arthritis models. In all the three models of anti-inflammatory studies 200 and 400mg/kg/p.o doses of the extract showed significant effect ($P<0.001$). Antinociceptive evaluation was performed by writhing and tail-immersion tests in mice. anti-nociceptive evaluation revealed that EEAT at the dose of 400mg/kg/p.o had significant activity against the control. The relieving effect was through the peripheral and central mechanism of action of the extract. This study rationalized the ethno medicinal use of the plant for relieving pain in inflammatory pathological conditions like fracture and dislocation.

Key Words: *Aerva tomentosa*, Carrageenan, Cotton pellet, Freund's adjuvant, Writhing test, Tail immersion test.

Introduction

Aerva tomentosa Linn. family *Amaranthaceae* and the genus *Aerva* comprises of sixty one species, distributed in the warm and desert parts of Asia and Africa. *Aerva tomentosa* is commonly known as desert cotton. *Aerva tomentosa* is a plant common to Central america, Asia, Africa, Pakistan, Sri Lanka and Myanmar. In India *Aerva tomentosa* is a deciduous dwarf shrub (up to 50-100 cm tall) widely distributed in Punjab, Rajasthan, Gujarat, Madhya Pradesh, Karnataka, Andhra Pradesh and Tamil Nadu. Leaves are small, alternate and of entire length of plant. Flowers are white and born on long spikes. Flowering period for this shrub is January, February, March, April, May, June and December. The shrub is suitable for pots, shrubbery and herbaceous border, propagated from seeds or cuttings. Flowers and seeds are used against swelling, headache and rheumatism (1,2,3). Roots and flowers are reported to possess medicinal properties against rheumatism and kidney problems. Plant is reported as anthelmintic, diuretic and demulcent (4). The decoction of the plant is administered to remove swellings (5), applied to acne like conditions of the face (6). Medicinal uses of this plant (leaves, seeds and the roots) in Ayurveda are used for treatment of kidney stones, and as astringent. Antimicrobial and hepatoprotective activities have also been demonstrated from its perianth lobes (7). Chemical compounds obtained: á - Amyrin and chrysin are obtained from this plant. Phytochemically ecdysteroids (20- hydroxyecdysone and 5, 20 dihydroxyecdysone) and alkaloids from the whole plant and aervanone, chrysin-7-Ogalactoside, β-sitosterol, α-amyrin and fatty acids from the roots have been reported (8).

The aim of the present study is to evaluate the anti-nociceptive and anti- inflammatory activity of *Aerva tomentosa.*

Materials and Methods

Plant material

The aerial parts of *Aerva tomentosa* (L) was collected from local supplier and was identified (BIS/DOB.21052) and authenticated by Dr. V. Venkata Pathi Raju, Botanist SK University, Anantapur, Andhra Pradesh India. A voucher specimen has been preserved in out laboratory for future reference. The aerial parts were dried under shade, powdered by a mechanical grinder and were passed through 40-mesh sieve and stored in airtight container for further use.

Preparation of Extract

About 1kg of the powdered plant material was exhaustively extracted using ethanol (90%) in a Soxhlet extractor. The ethanolic extracts were concentrated and the traces of the solvent were completely removed under reduced pressure and were stored in vacuum desiccator for further use. The yield of ethanolic extract was found to be (9.6%) w/w with respect to dried powder.

The dried extract was suspended in 2% Carboxy Methyl Cellulose (CMC) and used as test drug sample for the animal studies. Similarly, aspirin was suspended in 2% CMC and used as standard drug

Phytochemical Analysis

The dried extract was subjected to phytochemical analysis for constituent identification using standard protocol (9).

Animals

Wistar Albino rats (150-200g) and Swiss Albino mice (20-35g) of either sex were used in the studies. They were housed in large propylene cages and kept at 22±2°C in 12 h dark-light cycle. The animals were fed with rat pellet food and water ad libitum. All animals were acclimatized for at least one week before the experimental session. All the experimental procedures were done following the guidelines of Institutional Animal Ethics Committee (IAEC).

Drugs and Chemicals

Aspirin, carrageenan, Freund's adjuvant were purchased from Sigma, Pentazocine was purchased from Ranbaxy Lab Ltd, New Delhi, India. All other chemicals were of analytical grade and procured locally.

Anti-inflammatory activity

Carrageenan induced Paw Edema

Acute inflammation was produced by injecting 1% solution of carrageenan in to plantar surface of rat hind paw at the dose of 0.1ml per 100g body weight (10). Wistar albino rats were divided in to five groups of six in each. A 2% solution of CMC at a dose of 0.1ml/100g/p.o was administered to group 1. The test drug sample was administered to the animals of group 2, 3 and 4 at the dose range of 100, 200 and 400mg/kg/p.o respectively against the standard drug aspirin at 100mg/kg/p.o to the 5. After 30 minutes carrageenan solution was injected to the animals of all the groups. The paw edema was measured at the intervals of 1, 2, 3 and 4h using Plethysmometer (520-R, USA). The paw edema among the different group of animals was compared, Percentages of inhibition were obtained for each group using the following ratio:

$$[(V_t - V_o)\text{control} - (V_t - V_o)\text{treated}]/(V_t - V_o)\times 100$$

where V_t is the average volumes for each group and V_o the average volume obtained for each group before any treatment (11)

Cotton pellet induced granuloma

Two autoclaved cotton pellets weighing 10±1mg were implanted in both sides of the groin region of each rat (12, 13). The animals were divided into five groups of six each. The Control group received 2% CMC solution at the dose of 0.1ml/100g/p.o. The test groups were treated with test drug samples for seven consecutive days at the dose of 100, 200 and 400mg/kg/p.o. The standard group received aspirin at the dose of 100mg/kg p.o for seven days. After seven days animals were sacrificed by cervical dislocation and the cotton pellets along with the granuloma tissues were dried in an oven at 60°C, weighed and resulted weights were compared with the control. The percentage inhibition of granuloma by the test drug was determined.

Freund's adjuvant induced arthritis

Male albino rats were divided in to five groups. On day one 0.1ml of Freund's adjuvant was injected in to the plantar pad of each rat. The control group received 0.1ml/100g/p.o of 2% CMC solution consecutively for 21 days. The three test groups were treated with the test drug samples at the dose of 100, 200 and 400mg/kg/p.o for 21 days. The standard group received aspirin at 100mg/kg/p.o for 21 days (14). The paw edema of each group was measured using Plethysmometer (Model-520-R, USA) on day 1 before and on day 22 after drug administration. The percentage inhibition of arthritis (Paw edema) was calculated.

Anti-nociceptive activity

Tail-immersion test

Swiss albino mice of either sex (20-35g) were used in the study. Animals were divided into five groups of six each. Group 1 received 0.1ml of 2%CMC solution as control. The test drug EEAT was administered at the dose of 100, 200 and 400mg/kg p.o to the groups 2, 3 and 4 respectively against the standard drug Pentazocine administered to group 5 at the dose of 5mg/kg i.p .The animals were held in a suitable restrainer with tail extending out. The tail up to 5cm was then dipped into a pot of water maintained at 55±0.1°C (15).

The time taken for the mouse to withdraw the tail in seconds was considered as the reaction time. The reading was recorded after 30, 60 and 120 min of administration of drugs and control.

Acetic acid writhing test

Animals were divided in to five groups of six each. The control group received 0.1 ml of 2% CMC solution. The test groups were treated with 100, 200 and 400 mg/kg/p.o. of test drug samples. The standard group received aspirin at the dose of 100mg/ kg/p.o. After 30 min of drug administration 0.7% acetic acid was given to each mouse at the dose of 0.1 ml/10g body weight i.p. (16). Number of writhing was counted for 15 minutes. The percentage inhibition of writhing offered by the drug samples to the animals was calculated and compared with the control.

Statistical analysis

The values are represented by mean ± SEM; Student's t-test was performed. $P<0.05$ was considered as significant.

Results

Phytochemical analysis

Phytochemical study showed that EEAT tested positive for steroid, flavonoids and glycosides.

Anti-inflammatory activity

Carrageenan induced Paw Edema

The test drug EEAT at the dose of 100, 200 and 400 mg/kg p.o showed significant reduction in paw edema ($P<0.001$) after carrageenan administration. It was observed that EEAT at the dose of 400mg/kg /p.o produced 55.14 % percentage inhibition of paw edema (Table-1) at the 4th hr of drug administration, whereas, 64.48% was produced by aspirin.

Cotton pellet induced granuloma

In granuloma induced sub-acute inflammation model, the test drug EEAT at the dose of 200 and 400 mg/kg/p.o. had significant anti-inflammatory activity ($P<0.01$) (Table-2). The percentage inhibition of granuloma after drug administration was found to be 35.72% for EEAT at the dose of 400mg/kg/p.o and 41.88% for the standard drug aspirin.

Freund's adjuvant induced arthritis

In chronic inflammation induction model, the EEAT reduced the arthritis by 11.85% and 16.66% at the doses of 200 and 400mg/kg/p.o. respectively compared to the standard drug aspirin (100 mg/kg/p.o.) which reduced the arthritis by 31.28% (Table-3).

Anti-nociceptive activity

Tail-immersion test

Tail-immersion analgesic method revealed that EEAT at all the doses significantly delayed the time of tail withdrawal response by thermal induction of pain at 120 min ($P<0.001$). EEAT at the dose of 400mg/kg/p.o. showed significant protection from nociception at 30, 60 and 120 min similar to the standard drug Pentazocine 5mg/kg i.p. (Table-3).

Writhing test

The nociception induced by 0.7% acetic acid was significantly reduced by the EEAT in dose dependent manner (Table 4).

see Table 1.

see Table 2.

see Table 3.

see Table 4.

Discussion

Inflammatory events involve micro-vascular changes with increased vascular permeability, flow of exudation, including plasmatic protein and amplification of endogenous chemical mediators (17). Non Steroidal Anti-Inflammatory Drugs (NSAIDs) are the common drugs against superficial nociception and inflammation. NSAIDs alleviate the

hyperalgesic symptoms associated with inflammation by inhibiting the COX enzyme and the resultant inhibition of Prostaglandins synthesis from arachidonic acid (18). In this study a positive step was put forward to investigate the anti-nociceptive and anti-inflammatory actions of *Aerva tomentosa* utilized traditionally for nociception and inflammation. The ethanolic extract of the aerial parts of *Aerva tomentosa* was found to have significant (P<0.001) anti-inflammatory property in all the dose level in acute carrageenan induced paw edema, a test which has significant predictive value for anti-inflammatory agents acting by inhibiting the mediators of acute inflammation (19). In sub-acute and chronic studies, the inflammatory granuloma and arthritis are the typical features (20) which have been reduced significantly (P<0.01) by EEAT at the dose level of 200 and 400mg/kg. The percentage protections of inflammation at the dose level of 400mg/kg in acute, sub-acute and chronic model were 55.14 (at 4th hr), 35.72 and 13.91 respectively. It provided the feedback that EEAT was more effective in acute than sub-acute and chronic inflammation. The writhing induced by chemical substances is due to sensitization of nociceptors by Prostaglandins. This test is useful for evaluation of mild analgesic non-steroidal anti-inflammatory compounds (21).The ethanolic extract of the aerial parts of *Aerva tomentosa* at the dose level of 400mg/kg showed significant (P<0.001) inhibitory activity on the writhing induced by acetic acid when compared to control. Opioid type analgesics can be differentiated from NSAIDs by their effectiveness in the tail-immersion test (22). The tail immersion results depicted that the test drug EEAT at the dose level of 100, 200 and 400mg/kg gave significant response (P<0.001) at 120 min. Antinociceptive study by tail-immersion test provided the evidence for central mechanism which is also exhibited by the test drug for relieving the pain. The studies have rationalized the ethnomedicinal utility of the aerial parts of *Aerva tomentosa* for various ailments related to inflammatory disorders.

References

1. Chopra RN, Nayar SL and Chopra IC, Glossary of Indian Medicinal Plants. CSIR, New Delhi: 1956, p.194.
2. Bakshi GDN, Sarma PS and Pal DC, A Lexicon of Medicinal Plants in India. Naya Prokash, Calcutta: l999, p. 61-6.
3. Kirtikar KR and Basu BD, Indian Medicinal Plants. Oriental Enterprises, Dehradun: 2001, p2066-2077.
4. Dymock W, Warden CJH and Hooper D, Pharmacographia Indica, Hamdard Foundation Pakistan, Karachi. 1972; 3: 135-138.
5. Baquar SR and Tasnif M, Medicinal plants of Southern West Pakistan. Periodical Expert Book Agency, D-42, Vivek Vihar, Delhi. 1984, p.345.
6. Perry LM and Metzger J, Medicinal plants of East and Southeast Asia, MIT Press, Cambridge, London. 1980, p. 9-10.
7. Jaswant B, Ragunathan V and Sulochana N, A rare flavonol glycoside from Aerva
tomentosa Forsk. as antimicrobial and hepatoprotective agent. Indian J. Chem. 42 2003; 8(4): 956-958.
8. Garg SP, Bhushan R, Mehta R, Jain VM, Dutta BK and Indrani J, A survey for alkaloids in Rajasthan desert plants. Trans. Indian Soc. Desert Tecnol. Univ. Cent. Desert Stud., 1980;5 (2): 62-64.
9. Harborne JB, Phytochemical Methods. Chapman and Hall, London-New York. 1984, .p.120
10. Winter CA, and Risely GW .Carrageenan induced edema in hind paw of the rat as an assay for anti-inflammatory drug .Proc Soc Exp Biol Med. 1963;111:544.
11. Lanhers MC, Fleurentin J, Dorfman P, Mortier F, and Pelt JM, Analgesic, antipyretic and anti-inflammatory properties of Euphorbia hirta. Planta Medica. 1991;57: 225–231..
12. Sheth UK, Dadkar NK, Kamar UG, Selected Topics in Experimental Pharmacology. The Kothari Book Depot, Bombay, India, 1972, p.164–165.
13. Lassman HB, Kirby RE, Wilker JC, McFadden AR, Aultz DE, Hoffman D, Helsley GC, and Novick WJJ, Pharmacology of a new non-steroidal anti-inflammatory agent HP-549. Archives of International Pharmacodynamics. 1977; 227, 143–145.
14. Newbould B, Chemotherapy of arthritis induced in rats by mycobacterial adjuvants. Brit J Pharmacol. 1963; 21: 127.
15. Perianayagam JB, Sharma SK, Joseph A, and Christina AJM,.Evaluation of anti pyretic and analgesic activity of Emblica officinalis Gaertn. J.Ethnopharmacol. 2004; 95:83.
16. Hern´andez-P´erez M, and Rabanal RM, Evaluation of the anti-inflammatory and analgesic activity of Sideritis canariensis var. pannosa in mice. J Ethnopharmacol. 2002; 81, 43–47.
17. Collier HOJ, Dinneen LC, Johnson CA, and Scheider C, The abdominal contraction response and its suppression by antinociceptive drugs in the mouse. Br J Pharmacol Chemother.1968; 32:295.
18. Vane JR Inhibition of prostaglandin synthesis as a mechanism of action for aspirin like drugs. Nature 1971;31:232.
19. Mossa JS, Rafatullah S, Galal AM, and Al-Yahya MA,. Pharmacological studies of Rhus retinorrhaea. Int J Pharmacog. 1996; 33:242-246.
20. Olajide OA, Awe SO, Akinde JM, EkhelarAI, Olusola A, Morebise O, and Kpako DT, .Studies on the anti-inflammatory,antipyretic and analgesic properties of Alstonia boonei stem bark .J Ethnopharmacol. 2000;71:179-186
21. Ferreira SH, and Vane SR, New aspects on the mode of action of non-steroid anti-inflammatory drugs. Ann Rev Pharmacol. 1974; 14:57-73.
22. Turner RA, Screening Methods in Pharmacology. Academic Press, New York, 1965. .p.100

Treatment (mg/kg/p.o)	Paw volume in ml (% Inhibition Treatment of Paw Edema)			
	1h	2h	3h	4h
Control	1.52±0.036	1.84±0.061	2.11±0.008	2.14±0.073
EEAT-100	1.41±0.036*** (7.20)	1.34±0.005*** (27.17)	1.26±0.120*** (40.28)	1.24±0.020*** (42.05)
EEAT-200	1.32±0.004*** (13.15)	1.25±0.017*** (32.06)	1.10±0.034*** (42.86)	1.08±0.025*** (51.40)
EEAT-400	1.24±0.057*** (18.42)	1.14±0.028*** (38.04)	1.08±0.011*** (48.81)	0.96±0.002*** (55.14)
Aspirin-100	1.02±0.012*** (32.89)	0.86±0.022*** (53.26)	0.79±0.017*** (62.35)	0.76±0.052*** (64.48)

Table 1 Anti-inflammatory activity of EEAT on carrageenan induced paw edema in rats.

Data represent mean ± SEM of 6 animals. ***P<0.001 compared to control (Student's t-test), EEAT-ethanolic Extract of aerial parts of *Aerva tomentosa*

Treatment (mg/kg p.o)	Weight of dried cotton pellet %Inhibition of granuloma	Paw volume in ml %Inhibition of arthritis
Control	37.03±1.92	1.94±0.075
EEAT-100	31.90±0.64* (13.86)	1.75±0.020* (9.79)
EEAT-200	29.01±0.78** (21.65)	1.71±0.024** (11.85)
EEAT-400	23.80±0.77** (35.72)	1.67±0.013** (13.91)
Aspirin-100	21.52±0.82*** (41.88)	1.06±0.030*** (45.36)

Table 3 Antinociceptive activity of EEAT on thermally induced nociception in mice

Data represent mean±SEM of 6 animals. NS Non Significant,**P<0.01 and ***P<0.001 compared to control (student's t-test). EEAT-Ethanolic extract of roots of *Aerva tomentosa*

Treatment (mg/kg)	Tail flick after 30minutes (sec)	Tail flick after 60 minutes(sec)	Tail flick after 120 minutes(sec)
Control (p.o.)	22.78±0.45	1.59±0.335	2.43±0.314
EEAT -100 (p.o.)	3.15±0.336NS	4.18±0.456**	4.78±0.142***
EEAT- 200 (p.o.)	5.38±0.336**	6.45±0.830**	8.08±0.405***
EEAT- 400 (p.o.)	8.54±0.356***	12.28±1.260***	13.18±0.493***
Pentazocine- 5 (i.p.)	12.12±2.275***	14.43±0.805***	15.46±0.890***

Table 2 Anti-inflammatory activity of EEAT on Cotton pellet induced granuloma and Freund's adjuvant induced arthritis in rats.

Data Represent mean±SEM of 6 animals.*P<0.05, **P<0.01 and ***P<0.001 compared to control (student's t-test).
EEAT-ethanolic Extract of aerial parts of *Aerva tomentosa*

Treatment(mg/kg/p.o)	No. of writhing in 15 min	% Inhibition of Writhing
Control	32.51±3.14	------
EEAT- 100	25.17±1.42*	22.57
EEAT- 200	22.03±1.93**	32.23
EEAT- 400	16.62±1.84***	48.87
Aspirin -100	12.13±1.46***	62.68

Table 4. Antinociceptive effect of EEAT on acetic acid induced writhing in mice.

Data represent mean ± SEM of 6 animals.*P<0.05,**P<0.01 and ***P<0.001 compared to control. EEAT-Ethanolic extract of roots of *Aerva tomentosa*