Educational Administration: Theory and Practice
2024, 30(1), 802 - 810
ISSN: 2148-2403
https://kuey.net/

Research Article

Unravelling The Potential Analgesic Properties Of Achyranthes Aspera Extract: An Investigation Towards Natural Pain Management

Yashodhar Chaudhary[1], Ashwani Kumar[2*], Ved Prakash[3], Om Prakash Joshi[4]

[1,3]Research Scholar, Department of Pharmaceutical Sciences, Gurukula Kangri Deemed University Haridwar (Uttarakhand)- 249404.
[2*,4]Assistant Professor, Department of Pharmaceutical Sciences, Gurukula Kangri Deemed University Haridwar (Uttarakhand)- 249404.

Corresponding author: Ashwani Kumar
*2Assistant Professor, Department of Pharmaceutical Sciences, Gurukula Kangri Deemed University Haridwar (Uttarakhand)- 249404.

Citation Ashwani Kumar et. al (2024), Unravelling The Potential Analgesic Properties Of Achyranthes Aspera Extract: An Investigation Towards Natural Pain Management, *Educational Administration: Theory and Practice, 30(1),* 802 - 810
Doi: 10.53555/kuey.v30i6.5562

ARTICLE INFO

ABSTRACT

A sickness is "an impairment of the normal state of the living animal or plant body or one of its parts that interrupts or modifies the performance of the vital functions. The present research was based on the unravelling the potential analgesic properties of Achyranthes aspera extract. Achyranthes aspera Linn., belonging to family Amaranthaceae, is commonly found as a weed on way side and at waste places throughout India. A powder of dried leaf mixed with honey is useful in the early stages of asthma. The fresh stem of Achyranthes aspera was collected from Haridwar region and authenticated from a botanist with ref. no Bot.-Micro/0/2023 at Department of Botany and Microbiology, Gurukul Kangri (Deemed to be University), Haridwar. After weighing the powder, it was extracted through Soxhlet apparatus using distilled water. Using a rotary evaporator, the mixture's resulting slurry is dried under partial vacuum. Wistar rats of both sexes weighing 130-150g were obtained from Animal House, Gurukula Kangri Deemed University Haridwar (Uttarakhand). Rodents were divided into 4 groups (n=6) i.e., group 1: administered saline water daily, group 2: administered aspirin (150mg/kg, i. p.), group 3: administered aqueous stem extract of Achyranthes aspera (ASAA) (200mg/kg, i. p.) and group 4: administered aqueous stem extract of Achyranthes aspera (ASAA) (400mg/kg, i. p.) for 21 days. For evaluation of analgesic activity, parameters i.e., acetic acid-induced writhing test, hot plate and tail-flick were performed. In results, the aqueous stem extract of Achyranthes aspera (200mg/kg & 400mg/kg) exhibited statistically significant analgesic activity when compared with control group. They significantly increased the basal reaction time at diverse time intervals and activity was in dose-dependent manner. It might be due to presence of flavonoids and terpenoids. So, it might be effective in the management of pain and its subtypes. It refers to determine the mode of action that stem extract of Achyranthes aspera subsides pain.

Keywords: Achyranthes aspera, stem, analgesic activity, acetic acid-induced writhing test, tail-flick method.

INTRODUCTION

A sickness is "an impairment of the normal state of the living animal or plant body or one of its parts that interrupts or modifies the performance of the vital functions [1]. Disease is typified by distinctive signs and symptoms and is defined as a reaction to external stimuli, infectious agents, intrinsic defects, or a combination of these. Therefore, a disease's three primary characteristics are its etiopathogenesis, emergence of distinguishing symptoms, and impairment of normal functions [2]. Pain is anxious experience associated with possible tissue damage, according to IASP. The diversity of pain kinds can be explained by the four main categories of nociception, pain perception, suffering, and pain behaviours [3]. NSAIDs selectively relieves pain without appreciably affecting awareness by acting on the CNS or on peripheral pain mechanisms. Several pharmaceuticals are available for the treatment of pain. Aspirin and acetaminophen are examples of

moderate OTC medications, while general anesthetics are at the other end of the spectrum [4]. A medication that targets the central nervous system (CNS) or the peripheral pain mechanism to selectively alleviate pain. An analgesic is a pain reliever that has minimal cognitive effects. There are two categories of analgesics:

- Analgesics that work like opioids, morphine, etc.
- Antipyretics, anti-inflammatories, and pain relievers that aren't opiates or narcotics.

Opioids analgesics taken orally as "Tincture of laudanum," it first appeared in Britain around the close of the 17th century. These are the substances, natural or synthetic, that have the same impact on the body as morphine. The poppy (papaver somniferous) capsule yields a dark brown, resinous substance. It has two different alkaloid classes [5].

Plant profile: *Achyranthes aspera*

Achyranthes aspera Linn., belonging to family Amaranthaceae, is commonly found as a weed on way side and at waste places throughout India [6]. It is known as Apamarg in Sanskrit, Aghedo and Aghedi in Gujarati, Chirchira and Chirchitta in Hindi and Prickly chaff flower in English. It is widely used for asthmatic cough, snakebite, hydrophobia, urinary calculi, rabies, influenza, piles, bronchitis, diarrhea, renal dropsy, gonorrhea and abdominal pain [7]. A powder of dried leaf mixed with honey is useful in the early stages of asthma [8]. One of the drugs from Siddha system of medicine, Naayuruvi kuzhi thailum has A. aspera as the primary constituent is reported to be quite effective in the management of asthma [9].

Description

The T.S. of young stem shows 6-10 prominent ridges and collenchyma is present under each ridge. The epidermis is single layered, covered with thick cuticle. Trichomes arising from the epidermis are simple, covering, multicellular straight or somewhat spirally running, highly warty. The cortex is composed of 6 to 8 layers of parenchymatous cells containing cluster and rosette crystals of calcium oxalate. Xylem is composed of annular, spiral and pitted vessel. tracheids, fibres and parenchyma. The diagrammatic T.S. of the young root shows a layer of epiblema with long unicellular hairs. Cortex is 5-6 layered, parenchymatous and narrow. The stelar region shows anamolous growth. Upper epidermal cells of leaf are more or less straight walled while the lower ones are wavy walled. Both the upper and lower epidermal cells are traversed with anomocytic and few anisocytic stomata. Trichomes are simple, covering, uniseriate, multicellular and many, arising from the lower epidermis. Rosette crystals of calcium oxalate measuring 20-45 µin diameters are embedded throughout the parenchymatous cells of the mesophylls and the ground tissue of the mid rib [10].

Taxonomy [11]

Kingdom: Plantae
Phylum: Tracheophyta
Class: Magnoliopsida
Order: Caryophyllales
Family: Amaranthaceae
Genus: *Achyranthes*
Species: *aspera*

Fig 1. Depiction of *Achyranthes aspera* shrub

Chemical constituents

Betaine, 36,47- dihydroxyhenpentacontan-4-one, tritriacontanol, 17-pentatriacontanol, 27-cyclohexylheptacosan-7-ol, 16-hydroxy-26-methylheptacosan2-one, 4-methylheptatriacont-1-en-10-ol and tetracontanol-2, pentatriacontan, 6- pentatriacontanone, hexatriacontane, triacontane, methionine and cystine. It also reported for galactose, xylose, rhamnose, sapogenin, α -Lrhamnopyranosyl (1→4)-β-D-glucopyranosyl (1→4)-β-D-glucuronopyranosyl(1→3)-oleanolic acid and β-Dgalactoyranosyl (1→28), oleanolic acid., hexatriacontane, 10- octacosanone, 10-triacosanone and 4-triacontanone [12][13][14][15].

The current research based on the unravelling the potential analgesic properties of achyranthes aspera extract.

MATERIALS AND METHODS

Experimental Requirements

Achyranthes aspera, ethanol, distilled water, diclofenac and NaOH.

Digital weight balance, beaker, hot plate, laboratory thermometer and pH meter.

Collection, authentication, and extraction of the plant

The fresh stem of *Achyranthes aspera* was collected from Haridwar region and authenticated from a botanist with ref. no Bot.-Micro/0/2023 at Department of Botany and Microbiology, Gurukul Kangri (Deemed to be University), Haridwar. The stem was dried in the shade or at room temperature after being cleaned to remove any dust. First, the dried stem was ground into coarse powders, and subsequently into fine powders. After weighing the powder, it was extracted through Soxhlet apparatus using distilled water. Using a rotary evaporator, the mixture's resulting slurry is dried under partial vacuum. The formula below was used to get the percentage yield of the *Achyranthes aspera* extract. The percentage yield of *Achyranthes aspera* extract was calculated thru below mentioned formula [16]-

$$\text{percent yield} = \frac{\text{actual yield}}{\text{theoretical yield}} \times 100\%$$

Phytochemical screening

1. Detection of Alkaloids

Each extract was separately dissolved in diluted HCl before being filtered.

Mayer's Test: Potassium mercuric iodide, or Mayer's reagent, was applied to the filtrates. Alkaloids are present when a precipitate with a yellow hue forms.

Wagner's Test: Wagner's reagent, which is iodine in potassium iodide, was applied to the filtrates. Alkaloids are present when a brown or reddish precipitate forms.

Hager's Test: Hagers Reagent was used to treat the filtrates. The appearance of yellow precipitation suggests the presence of alkaloids.

Detection of Glycosides

Fehling's test: With distilled water dilution, Fehling's solutions A and B were heated for one minute. There were 8 drops of plant extract added to this transparent blue solution. It was then combined with 1 ml of Fehling's solution and heated for 5 minutes in a water bath. Brick red precipitation is an indication of glycoside content.

Detection of Saponins

Foam test: For a stable, long-lasting froth, about 2g of the plant extract was combined with 10ml of distilled water and vigorously shaken. Saponins are indicated by the appearance of foam [17].

2. Detection of Tannins

Ferric chloride test: In a test tube, 0.5 grams of the dried powdered material was cooked in 20 milliliters of water before being filtered. After adding a few drops of 0.1% FeCl3, the coloration was checked for brownish green-black or blue-black.

Lead acetate test 2 ml of distilled water and 2 ml of plant extract were mixed together. After adding 0.01g of lead acetate to the mixture, give it a good shake. Tannins are present when white turbidity and precipitate develop [18].

3. Detection of Flavonoids

NaOH test: After treating a little amount of extract with aqueous NaOH and HCl, the production of a yellow-orange color was noticed.

H_2SO_4 test: Conc.H2SO4 was applied to a portion of the extract, and the production of orange color was monitored.

5. Detection of terpenoids

After mixing 2.0 ml of chloroform with 5 ml of the aqueous plant extract, the mixture was added, allowed to evaporate on the water route, and then heated to a boil using 3 ml of concentrated H2SO4. A grey coloration developed as terpenoids took shape.

6. Detection of Steroids

5 ml of aqueous plant crude extract was combined with 2 ml of chloroform and concentrated H2SO4. The presence of steroids was detected by the appearance of red hue in the lower chloroform layer.

7. Tests for sugars and carbohydrates

Molisch's test

Add a few drops of α-naphthol solution in alcohol to 2-3 ml of extract of each solvent, agitate, and then add concentrate H2SO4 from the test tube's sides. a violet ring where two liquids converge.

Fehling's test

It is utilised to find decreasing sugars. Make a volume of 500 mL by dissolving 34.66 grammes of copper sulphate in distilled water (solution A). 50 grammes of sodium hydroxide and 17.3 grammes of potassium sodium tartrate should be dissolved in distilled water to a volume of up to 50 millilitres (Solution B). Prior to usage, combine two solutions in an equal volume. Fehling's A and B solution in a 1 mL mixture should be boiled for one minute. Equal parts of the test solution should be added. Heat for five to ten minutes in a kettle of boiling water. There came a flash of brick red, followed by yellow.

Animal preparation

Wistar rats of both sexes weighing 130-150g were obtained from Animal House, Gurukula Kangri Deemed University Haridwar (Uttarakhand). The rats were maintained in good condition using a 12-hour light and dark cycle and a room temperature of 25°C. A regular mouse feed and unrestricted access to water were provided, and the relative humidity was maintained at 50±2%. The rats maintained their fast while having unrestricted access to water until one hour before to the study's start [19].

Experimental design

Rodents were divided into 4 groups (n=6) as below-
Group 1: administered saline water daily up to 21 days.
Group 2: administered aspirin (150mg/kg, i. p.) for 21 days.
Group 3: administered aqueous stem extract of *Achyranthes aspera* (ASAA) (200mg/kg, i. p.) for 21 days.
Group 4: administered aqueous stem extract of *Achyranthes aspera* (ASAA) (400mg/kg, i. p.) for 21 days.

Evaluation parameters

- **Acetic Acid-Induced Writhing Test**

The purpose of this test was to determine the herbal extract's peripheral analgesic activity. A vehicle was administered to one group as a negative control, and two groups received varying doses of the leaves extract. A conventional medicine, such as aspirin, was given to the other group as a positive control at 150mg/kg one hour before to the administration of acetic acid. Sixty minutes later, the number of writhes elicited by 0.6% acetic acid (10ml/kg, i. p.) was used to evaluate the analgesic activity of *Achyranthes aspera*. The animals were placed in an inverted flask five minutes after the acetic acid injection, and for the next twenty minutes, the total number of abdominal muscle contractions and hindlimb stretches was recorded [20].

- **Hot plate method**

Animals placed on a hot plate kept at a constant temperature of 55°C were observed for their basal reaction time, which was measured by watching for the first apparent behavior, such as licking of the hind paws or jumping. This response was observed in 6-8 seconds. To prevent harm to the paws, a 10-second time limit was observed and used as the cutoff point. To ensure that the rats were acting normally, at least three to five basal reaction times were recorded for each rat at intervals of five minutes. Following the medication, the reaction times at 15, 30, 45, 60, and 90 minutes were recorded. In order to prevent damage to the paws, the animals were taken off the hot plate as soon as the reaction time reached 10 seconds, which was deemed to be maximum analgesia. Each time, the percentage increase in reaction time (analgesia index) was calculated, and the test compound's statistics were compared to those of the standard medication [21].

- **Tail-flick method**

By placing the tip of the tail- the final 1-2 centimetres on the radiant heat source and submerging it in hot water that was kept at 58°C, the basal reaction time to radiant heat was measured. The end point is determined by the rat's tail-withdrawal from the heat (flicking response), which typically occurs in three to five seconds. A 10- to 12-second cutoff time is observed to avoid damaging the tail. To ensure that the rats were acting normally, at least three to five basal reaction times were recorded for each rat at intervals of five

minutes. Following the medication, the reaction times at 15, 30, 45, 60, and 90 minutes were recorded. The tail was taken out of the heat source to prevent tissue damage as soon as the reaction time reached 10 seconds, which was deemed to be maximum analgesia. Each time, the percentage increase in reaction time (analgesia index) was calculated, and the test compound's statistics were compared to those of the standard medication [21].

RESULTS AND DISCUSSION

Percentage yield

The percentage yield for aqueous stem extract of *Achyranthes aspera* was found to be 63.28% when calculated based on practical yield.

Phytochemicals screening

The aqueous stem extract of *Achyranthes aspera* showed as a rich source for diverse phytochemicals as follows-

Table 1. Phytochemicals of aqueous stem extract of *Achyranthes aspera*

Phytochemicals	Aqueous stem extract of *Achyranthes aspera*
Carbohydrates	++
Alkaloids	++
Glycosides	++
Flavonoids	++
Tannins	+
Saponins	++
Triterpenoids	+
Steroids	_

Absent (-), Present (+), Abundance (++)

Evaluation of analgesic activity

➢ Acetic Acid-Induced Writhing Test

In acetic acid-induced writhing test, stem extract of *Achyranthes aspera* was evaluated for analgesic activity. The number of writhing was observed for all the group of animals. Eventually, % inhibition was recorded for all the rats. Aspirin was used as a standard drug.

In observation, the no. of writing was observed as 27.31 ±0.28 and nil, % inhibition in control group. However, aqueous stem extract of *Achyranthes aspera* (ASAA) (200mg/kg, i. p.) treated rats showed the no. of writing as 09.20 ±0.18 and thus % inhibition of 82.72%. Moreover, at higher dose (200mg/kg, i. p.) aqueous stem extract of *Achyranthes aspera* showed the no. of writing as 6.14 ±0.34 and similarly the % inhibition of 77.52%. Therefore, the effect of herbal extract was significant when compared with the control group.

Table 2. Effect of aqueous stem extract of *Achyranthes aspera* on Acetic Acid-Induced Writhing in rats

Treatment	No. of Writhing (mean)	% Inhibition
Saline water	27.31 ±0.28	---
Aspirin (150mg/kg)	4.72 ±0.36	82.72
Aqueous stem extract of *Achyranthes aspera* (ASAA) (200mg/kg, i. p.)	09.20 ±0.18	66.32
Aqueous stem extract of *Achyranthes aspera* (ASAA) (400mg/kg, i. p.)	6.14 ±0.34	77.52

Level of significance= P<0.05, P<0.01, P< 0.001

When compared to the control group (n=6), experimental values were significantly different at the ≤P0.05 level.

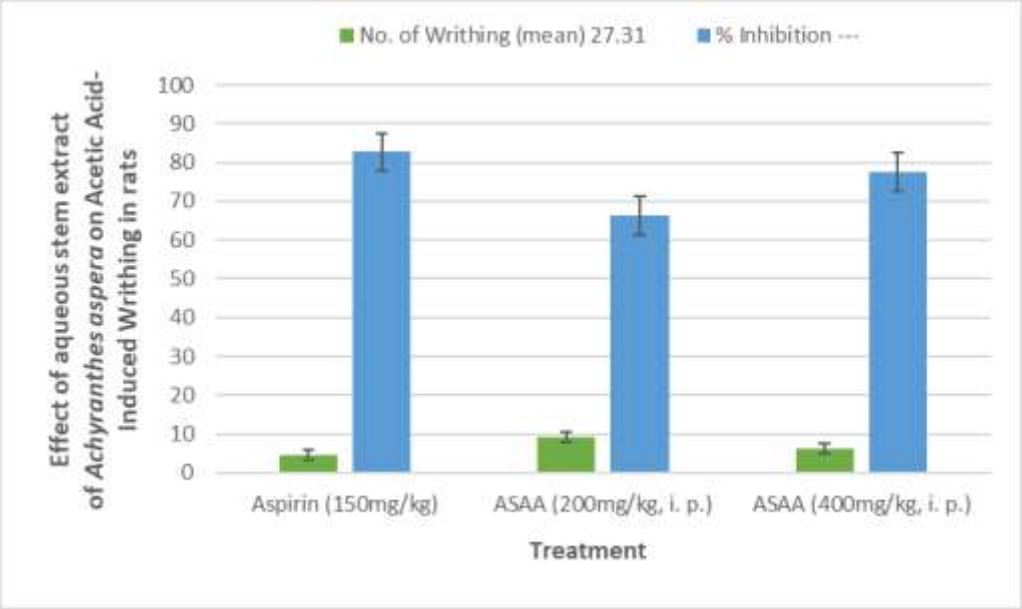

Fig 2. Effect of aqueous stem extract of *Achyranthes aspera* on Acetic Acid-Induced Writhing in rats

➢ Hot plate method

In hot plate method, stem extract of *Achyranthes aspera* was evaluated for analgesic activity. The basal reaction time (sec) was observed for all the group of animals. Aspirin was used as a standard drug. It was observed at time intervals of 0 min, 30 min, 45 min, 60 min and 90 min.

The maximum basal reaction time was observed at 90 min, as 4.64±0.12 sec in Aqueous stem extract of *Achyranthes aspera* (ASAA) (200mg/kg, i. p.) treated animals. However, the control group exhibited the basal reaction time as 2.51±0.26 sec. Thus, stem extract at both dose levels shown pharmacological effect in dose-dependent manner. In hot plate model, herbal extract was shown increasing basal reaction time when the paws of animals were touched to the hot plate. It represents that stem extract of plant is effective in pain-relieving.

Table 3. Basal reaction time of *Achyranthes aspera* in hot-plate model

Treatment	**Basal reaction time (sec)**				
	15 min	**30 min**	**45 min**	**60 min**	**90 min**
Saline water	2.32±0.17	2.48±0.10	2.54±0.26	2.47±0.12	2.51±0.26
Aspirin (150mg/kg)	2.64±0.25	3.41±0.27	3.81±0.28	4.42±0.19	5.51±0.38
Aqueous stem extract of *Achyranthes aspera* (ASAA) (200mg/kg, i. p.)	2.35±0.11	2.59±0.14	2.72±0.12	3.25±0.10	3.49±0.13
Aqueous stem extract of *Achyranthes aspera* (ASAA) (400mg/kg, i. p.)	2.41±0.27	3.25±0.19	3.16±0.19	3.83±0.22	4.64±0.12

Level of significance= P<0.05, P<0.01, P< 0.001

When compared to the control group (n=6), experimental values were significantly different at the ≤P0.05 level.

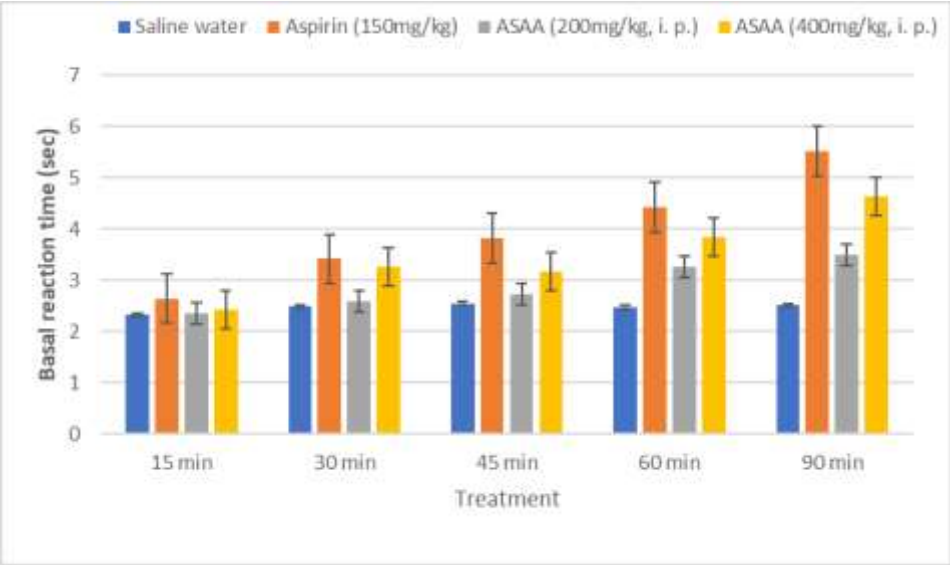

Fig 3. Basal reaction time of *Achyranthes aspera* in hot-plate model

➢ Tail-flick method

In tail-flick model, stem extract of *Achyranthes aspera* was evaluated for analgesic activity. The basal reaction time (sec) was observed for all the group of animals. Aspirin was used as a standard drug. It was observed at time intervals of 0 min, 30 min, 45 min, 60 min and 90 min.

The stem extract of *Achyranthes aspera* was shown increasing basal reaction time when the tail of animals was dipped in the hot water. Basal reaction was tested in control, aspirin (std) and test group that was administered herbal extract at dose of 200mg/kg and 400mg/kg.

At 90 min, aqueous stem extract of *Achyranthes aspera* (ASAA) (200mg/kg, i. p.) demonstrated the basal reaction time as 4.58±0.14 sec and control group showed the basal reaction time as 2.53±0.24 sec. It represented that herbal extract has effective analgesic property.

Table 4. Basal reaction time of *Achyranthes aspera* in tail-flick model

Treatment	Basal reaction time (sec)				
	15 min	30 min	45 min	60 min	90 min
Saline water	2.29±0.17	2.48±0.12	2.56±0.26	2.47±0.12	2.53±0.24
Aspirin (150mg/kg)	2.67±0.20	3.46±0.29	3.89±0.24	4.37±0.15	5.62±0.11
Aqueous stem extract of *Achyranthes aspera* (ASAA) (200mg/kg, i. p.)	2.39±0.12	2.62±0.18	2.61±0.21	3.84±0.35	4.12±0.26
Aqueous stem extract of *Achyranthes aspera* (ASAA) (400mg/kg, i. p.)	2.43±0.34	3.12±0.29	3.74±0.12	3.97±0.18	4.58±0.14

Level of significance= P<0.05, P<0.01, P< 0.001

Values were given in Mean ± S.E.M. and found statistically significant at P<0.05, compared to control (n=6).

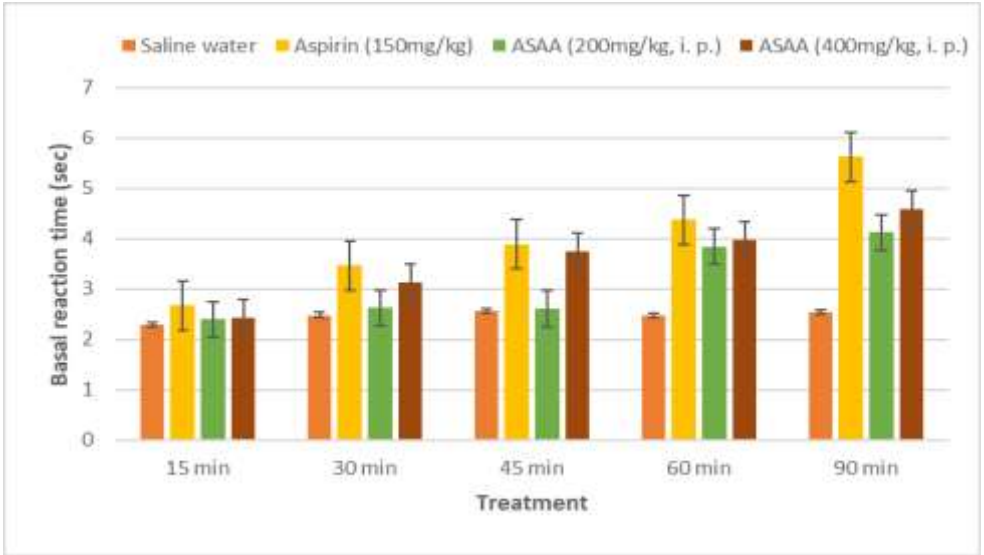

Fig 4. Basal reaction time of *Achyranthes aspera* in tail-flick model

Although G. purpurascens leaf and root extracts have long been used in Ethiopia as analgesics and anti-inflammatory medications, no proof of the plant's ability to reduce pain and inflammation in models of pain and inflammation has been discovered. Consequently, the aim of this investigation was to assess the traditional usage of G. purpurascens in a scientific manner. Methanol was the solvent of choice in this study for extracting the root and leaves of G. purpurasence because hydro alcoholic co-solvents have the finest solubility properties for first extraction and because it is a universal solvent for extraction [22].

The acetic acid-induced writhing test, which is utilized for a fast and accurate assessment of the peripheral analgesic action of plants, was employed to determine the extracts' peripheral analgesic efficacy. It is a non-selective pain test that produces false positive results with sedatives, muscle relaxants, and other pharmacological agents, but it is a very sensitive test that can detect anti-nociceptive effects of compounds at dose levels that may appear inactive in other methods like the hot plate test. because it involves various nociceptive systems, including substance P (SP), bradykinins, biogenic amine release (e.g., histamine and serotonin, 5-HT), and pro-inflammatory cytokines (e.g., tumor necrosis factor, TNF-α, and interleukin, IL-1β). Comparing the methanol 80% crude extracts of this plant's root to the negative control, a notable peripheral analgesic effect was observed. One indication of the plant's peripheral analgesic effects is the reduction of the writhing reaction. The root extract reduced the writhing response in an acetic acid-induced writhing paradigm by 16.6%, 68.9%, and 83% at 100, 200, and 400 mg/kg, respectively. According to the previously mentioned results, the extract exhibits dose-dependent analgesic action, meaning that an increase in dose corresponds with a corresponding increase in analgesic activity. This suggests that the concentration of phytoconstituents exhibiting analgesic activity is elevated. The impact of the extract was similar to that of acetylsalicylic acid, a popular NSAID that inhibits the effects of acetic acid by removing inflammatory mediators of pain in peripheral tissues [23][24].

The hot plate model, which measures mice's pain threshold in response to heat, is frequently used to investigate medications that exhibit central mechanism analgesia. This test was selected because it has a 15-second cutoff time, which is frequently employed to protect mice from harm, and it is responsive to potent analgesics with minimal tissue damage [25]. An 80% methanolic extract of G. purpurasence roots demonstrated significant central analgesic efficacy at dosages of 200 mg/kg and 400 mg/kg. This could be because alkaloids are present, which are known to have analgesic effects by blocking CNS neurotransmitters that enhance pain, or it could be because alkaloids interact with other receptors located in supraspinal areas [26].

In results, the aqueous stem extract of *Achyranthes aspera* (200mg/kg & 400mg/kg) exhibited statistically significant analgesic activity when compared with control group. They significantly increased the basal reaction time at diverse time intervals and activity was in dose-dependent manner. It might be due to presence of flavonoids and terpenoids. Analgesic action might be due to blockade of inflammatory mediators like interleukins, thromboxane, cytokines etc.

CONCLUSION

However, research into the mechanisms underlying these effects is necessary before we can fully understand the process by which anti-inflammatory, analgesic, and anti-pyretic function. Pharmaceutical researchers might use the information we uncovered to improve the efficiency and quality of their drug discovery efforts by modifying this structure to improve the pharmacokinetic profile and address the problems associated with the side effects of conventional analgesics and NSAID. Pain has become a most common sign & symptom of many illnesses.

So, it might be effective in the management of pain and its subtypes. It might be given in central or peripheral pain which is most common symptom of many medical conditions or injury. It would be cost-effective with easy availability among society. It refers to determine the mode of action that stem extract of *Achyranthes aspera* subsides pain.

FUNDING

Nil.

CONLFICT OF INTEREST

Authors declared for none conflict of interest.

REFERENCES

1. Jackson T, Stabile V, McQueen K. The Global Burden of Chronic Pain. 2017.
2. Jackson T, Thomas S, Stabile V, Han X, Shotwell M, McQueen K. Prevalence of chronic pain in low-income and middle-income countries: a systematic review and meta-analysis. Lancet. 2015;385(Suppl 2):S10.

3. Dhotre Bhagyashree Gopalrao, Syeda Farheen F. Formulation and Evaluation Ofbuccal Tablets: A Review. IJCRT, 2021; 9(4): 1855-1868.
4. Sahib Mehdi El-Radhi A. Fever management: Evidence vs current practice. World J Clin Pediatr. 2012 Dec 8; 1(4): 29–33.
5. Cady R.K., Schreiber C.P., Beach M.E., Hart C.C., (2005). Gelstat Migraine (sublingually administered feverfew and ginger compound) for acute treatment of migraine when 201 administered during the mild pain phase. Medical Science Monitor: International Medical Journal of Experimental and Clinical Research 11: PI65-69.
6. Pandey NK, Sharma HP, Patnaik A, Jain P (2013) A review on potential magic folk herbal medicinal plant: Achyranthus aspera L. International J of Medicinal Plants Photon 105: 350-363.
7. Hariharan V, Rangaswami S (1970) Structure of saponin A and B from the seeds of Achyranthes aspera. Phytochemistry 9(2): 409-414.
8. Singh S, Singh S, Navneet, Srivastava V (2018) Ethnobotanical and Pharmacological Benefits of Achyranthes aspera Linn: An overview. Int J Pharm Sci Rev Res 48(2): 1-7.
9. Gupta RK (2010) Medicinal & Aromatic Plants. CBS publishers & distributors 3(1): 190.
10. Akter A, Zuberi MI (2009) Invasive alien species in Northern Bangladesh: Identification, inventory and impacts. International J of Biodiversity and Conservation 1(5): 129-134.
11. Srivastav S, Singh P, Mishra G, Jha KK, Khosa RL (2011) Pharmacological and Medicinal use of Achyranthus aspera: A review. J Nat Prod Plant Resource 1(1): 1-14.
12. Jaryan V, Uniyal SK, Gopichand, Singh RD, Lal B, et al. (2009) Role of traditional conservation practice: highlighting the importance of Shivbari sacred grove in biodiversity conservation. The Environmentalist 30(2): 101-110.
13. Ranjan V (1999) Exotic medicinal plants of district Lalitpur, Uttar Pradesh. Bulletin of Medico Ethno Botanical Research 20(1-4): 54-65.
14. Krishnaveni A, Thakur SR (2006) Pharmacogenetic and preliminary phytochemical studies of Achyranthes aspera Linn. Anc Sci Life 26(1-2): 1-5.
15. Rameshwar RD, Akito N (2007) Three Oleanolic Acid Glycosides from the Seeds of Achyranthes aspera. Natural Product Communications 2(7): 727-730.
16. Kokate C.K, Purohit A.P and Gokhale S.B, 2006. Pharmacognosy,45 edition, Nirali prakashan, Pune, 6.17-6.19.
17. Khandelwal K R. (2002). Practical Pharnacognosy, Nirali Prakashan, Pune, 9th Edition, 157-158.
18. Bhatt J. S. and S. Dhyani, (2012). Preliminary Phytochemical Screening of Ailanthus Excelsa Roxb., Int. J. Curr. Pharmaceut. Res., 4(1), 87-89.
19. Bhajoni et al. Evaluation of the Antiulcer Activity of the Leaves of Azadirachta indica: An Experimental Study. Integrative Medicine International, 2016; 3:10–16.
20. Yohannes T, Teshome N, Ephrem E. Analgesic and anti-inflammatory activities of 80% methanol root extract of Jasminum abyssinicum Hochst. ex. Dc. (Oleaceae) in mice. J Ethnopharmacol. 2017;8741(16):31812–31818.
21. Das SC, Bhadra S, Roy S. Analgesic and anti-inflammatory activities of ethanolic root extract of Swertia chirata (Gentianaceae). Jordan J Biol Sci. 2012;5(1):31–36.
22. Gupta A, Naraniwal M, Kothari V. Modern extraction methods for preparation of bioactive plant extracts. IJANS. 2012;1(1):8–26.
23. Yohannes T, Teshome N, Ephrem E. Analgesic and anti-inflammatory activities of 80% methanol root extract of Jasminum abyssinicum Hochst. ex. Dc. (Oleaceae) in mice. J Ethnopharmacol. 2017;8741(16):31812–31818.
24. Das SC, Bhadra S, Roy S. Analgesic and anti-inflammatory activities of ethanolic root extract of Swertia chirata (Gentianaceae). Jordan J Biol Sci. 2012;5(1):31–36.
25. Siddalingappa CM, Rajesh T, Kudagi BL. Evaluation of analgesic and anti-inflammatory activities of Tinospora cordifolia in rodents. Int J Medical Sci. 2012;2(6):305–311.
26. Cadirci E, Suleyman H, Gurbuz P, et al. Anti-inflammatory effects of different extracts from three Salvia species. Turk J Biol. 2012;36:59–64.