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Research Article

Anti-inflammatory and Analgesic Effects of Aqueous Extract of Aloe Vera (*Aloe barbadensis*) in Rats

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ABSTRACT: The anti-inflammatory and analgesic activities of aqueous extract of *Aloe barbadensis* was investigated in rats. Formalin- induced hind paw oedema was used to assess the anti- inflammatory activity of the extract while acetic acid-induced abdominal writhing was used for analgesic activity. The results of the anti-inflammatory study revealed that 25, 50 and 100 mg/kg of the extract reduced the formalin-induced oedema significantly ($P<0.05$) at the beginning of 3 hours when compared to the control group. In the analgesic study, 25, 50 and 100 mg/kg of extract significantly ($P<0.5$) reduced the number of writhes induced by a 0.6% Acetic acid solution with an approximately 66.49%, 57.59% and 68.06% inhibition respectively. The present study showed that the aqueous extract of *Aloe barbadensis* has anti-inflammatory and analgesic activities that could be mediated via modulators of pain and inflammation or through central activity.

Keywords: *Aloe barbadensis;* anti-inflammatory; analgesic activity

INTRODUCTION

Pain refers to the subjective, unpleasant sensation that accompanies damage or near damage to tissues. Though it can also occur in the absence of such damage. Chemicals released locally as a results of cell injury either produces pain by direct stimulation or by stimulation of nerve endings responsible for the mediation of pain (Clark, 2001).

Inflammation is a complex biological response of vascular tissues to harmful stimuli such as pathogens, damaged cells or irritants. In the absence of inflammation, wounds and infections would never heal and progressive destruction of the tissues would compromise the survival of the organism. Although it is a defense mechanism, the complex events and mediators involved in inflammatory reaction can be induced, maintained and aggravated by many diseases (Malaya *et al.*, 2003).

Aloe barbadensis, is a member of Liliaceae family, is a spiky, succulent, perennial plant. Aloe species are cultivated as ornamental plants both in garden and in pots. Reynolds, (2004), observed that it grows best in full sunshine and does not require much water. It also requires sandy and well-drained soil. *Aloe barba densis* has been used topically for cuts, burns, insect stings, bruises, acne and blemishes, poison ivy, welts, skin lesions, eczema and sun burns. Aloe also has a history of traditional uses by native Americans for stomach disorder and intestinal disorder including constipation, hemorrhoids, colitis and colon problems. Additionally, numerous constituents within *Aloe barbadensis* have demonstrated enhancement of immune system functioning within the body.

In this work, we investigated the analgesic and anti-inflammatory effect of the aqueous leaf extract of *Aloe barbadensis* in rats to ascertain its acclaimed use in traditional medicine.

MATERIALS AND METHODS:

Plant Materials

Aloe barbadensis was purchased from a local supplier in Jos, Plateau State, Nigeria on September 2010 and

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authenticated by a taxonomist in the federal College of Forestry Jos.

Preparation of Extract

The fresh spiny leaves of *Aloe barbadensis* were dried under a shade and reduced to a coarse powder using a mortar and 50g of the powder was soxhlet extracted with 250 ml of distilled water at 100^0C for 72hours. The extract was slowly evaporated to dryness using a rotary evaporation at 40^0C to yield 6.18% W/V of dry weight of residue which was stored at – 4^OC until use.

Animals

Wistar rats of either sex (weighing 145 – 250 g) were obtained from the animal house unit of University of Jos, Jos Nigeria. The animals were housed under standard environmental conditions and fed and water provided *ad libitum*.

Formalin – Induced Hind Paw Oedema

The increase in the rats hind paw linear diameter induced by sub plantar injection of formalin was used as the measure of acute inflammation. The animals were divided into 5 groups, of 5 rats each. Control group received normal saline, the second group of rats received Diclofenac Sodium 25 mg/kg i.p. and the remaining three group received *Aloe barbadensis* extract (25 mg/kg, 50 mg/kg and 100 mg/kg i.p). Thirty minutes after injection, acute inflammation was induced by subcutaneous injection of 0.02 ml of a 2.5% solution of formalin under the subplantar region of the left hind paw of each rat. Oedema was assessed in terms of the linear diameter at the injected hind paw using vernier caliber at 1,2,3,4 and 5 hours intervals of formalin injection so as to estimate the degree of inflammation and percentage inhibition of oedema.

Acetic Acid-Induced Abdominal Writhing Test.

The animals were divided into 5 group, of 5 rats each. Control group received normal saline, the second group of rats received piroxicam 20 mg/kg i.p. and the remaining three groups received *Aloe barbadensis* extract (25 mg/kg, 50 mg/kg and 100 mg/kg i.p.). Thirty minutes later, each rat was given i.p. injection of 0.6% Acetic Acid 1ml/kg. The writhing response per animal was recorded five minutes after Acetic Acid injection for duration of ten minutes. A writhe was indicated by abdominal contraction and stretching of the hind limbs (Cavero and Larid, 1999). The analgesic activity was expressed as percentage inhibition of abdominal contraction between control group and extract treated groups.

Statistical Analysis

Data are expressed as mean ± standard error of mean (SEM) and analysed using the ANOVA. $P < 0.05$ was accepted as significant.

RESULTS

The effects of aqueous extract of *Aloe barbadensis* on formalin-induced hind paw oedema in rats are shown in Table 1. The effects of aqueous extract of *Aloe barbadensis* on acetic acid-induced abdominal writhing in rats shown in Table 2. The experiments revealed significant difference between rat groups treated with the extract and that of the control (Table1).

Table 1:
Effect of aqueous extract of *Aloe barbadensis* on formalin-induced hind paw oedema in rats

Time (hours)	**EDEMA VOLUME (CM) FOR DIFFERENT GROUPS**				
	Normal saline	Diclofenac sodium (25 mg/kg)	Aqueous extract (25 mg/kg)	Aqueous extract (50 mg/kg)	Aqueous extract (100 mg/kg)
1	0.56± 0.03	0.49±0.02 (12.50%) ^{NS}	0.51±0.02 (8.93%) ^{NS}	0.51±0.02 (8.93%) ^{NS}	0.52±0.07 (7.14%) ^{NS}
2	0.65±0.02	0.52±0.01(20.0%) ^{S}	0.56±0.03 (13.85%) ^{S}	0.58±0.03 (10.77%) ^{NS}	0.47±0.03 (27.69%) S
3	0.70±0.01	0.51±0.00 (27.14%) ^{S}	0.53±0.03 (24.29%)^{S}	0.57±0.02 (18.57%)^{S}	0.52±0.04 (25.71%)^{S}
4	0.75±0.01	0.48±0.01 (36.0%) ^{S}	0.52±0.03 (30.67%) ^{S}	0.53±0.02 (29.33%) ^{S}	0.48±0.04 (36.0%)^{S}
5	0.79±0.01	0.46±0.02 (41.77%) ^{S}	0.49±0.02 (37.97%) ^{S}	0.48±0.02 (39.24%) ^{S}	0.46±0.03 (41.77%) ^{S}

- *Each value represents the mean ±S.E.M of the paw diameter of five rats in each group (n=5).*
- *Figures in parenthesis indicate the % anti-inflammatory activity.*
- *All values are significant at P<0.05 compared to control group.*
- *S indicates statistical significance.*
- *NS indicates statistically not significance.*

Table 2:
Effect of aqueous extract of *Aloe barbadensis* on acetic acid-induced abdominal writhing in rats

Groups	Doses (mg/kg)	No of writhe	% inhibition
Normal saline	-	38.20±3.07	-
Piroxicam	20	14.00±1.76^{S}	63.35%
Extract	25	12.80±0.86^{S}	66.49%
Extract	50	16.20±2.75^{S}	57.59%
Extract	100	12.20±1.02^{S}	68.06%

- *Each value represent the mean ± S.E.M. of 5 rats in each group (n=5)*
- *All values are significant at p<0.05 compared to control group*
- *S indicates statistical significance*

After 5 hours the extract at 25 mg/kg, 50 mg/kg and 100 mg/kg produced an inhibition of 37.97%, 39.24% and 41.77% respectively. While the standard drug Diclofenac sodium 25 mg/kg produced 41.77% inhibition of inflammation in rats. This signifies good anti-inflammatory properties of the extract as compared to standard. There was a statistical significant difference (P<0.05) for the number of writhes for all the doses of the extract used compared with control (table 2). The analgesic effect produced by the extract at 25 mg/kg, 50 mg/kg and 100 mg/kg are 66.49%, 57.59% and 68.06% respectively while the standard drug piroxicam 20 mg/kg produced 63.35% inhibition in rats.

DISCUSSION

The aqueous extract of *Aloe barbadensis* produces a significant analgesic and anti-inflammatory effect as compared to control. The significant anti-inflammatory effect was indicated by the decrease in paw oedema while the analgesic effect was indicated by the decrease in number of writhe. A writhe was indicated by abdominal contraction and stretching of the hind limbs.
The increase in rats hind paw linear diameter induced by sub plantar injection of formalin was used as the measure of acute inflammation (Winter *et al.,* 1963). Formalin which is a potent oedematous agent produced inflammation through the release of several inflammatory mediators including prostaglandins. Aqueous extract of the *Aloe barbadensis* at doses of 25 mg and 100 mg/kg reduced the formalin-induced oedema significantly (P<0.05) at the beginning of 3 hours when compared to the control group. The reference drug, diclofenac sodium has 41.77% anti-inflammatory activity, same with the extract 100 mg/kg which had a more potent anti-inflammatory activity when compared with other extract treated groups 25 mg/kg and 50 mg/kg.

Since most anti-inflammatory agents inhibits cyclooxygenase enzyme involved in prostaglandin synthesis at the site of inflammation, the anti-inflammatory effect of *Aloe barbadensis* may involve prostaglandin synthesis inhibition. Also among the major constituent of *Aloe barbadensis*, anti-inflammatory activity has been reported for Lupeol (which is one of the sterol compound found in *Aloe barbadensis*), gibberllins, mannose -6- phosphate (which is of the sugar found in the gel) and the peptidase bradykinase which was isolated from *Aloe* and shown to breakdown bradykinin an inflammatory substance that induce pain (Ito *et al.,* 1993).
Intraperitoneal administration of acetic acid produced an abdominal writhing response by activating the chemosensitive nociceptors in animals. Aqueous extract of *Aloe barbadensis* of 25, 50 and 100 mg/kg significantly reduced the number of writhe induced by a 0.06% Acetic acid solution with an approximately 66.49%, 57.59% and 68.06% inhibition respectively. While the standard drug, piroxicam, exhibited a protective effect of 63.35%. It is possible that the analgesic effect of the extract could be as a result of its central activity. The results of the present study are consistent with the results of the study carried out by Davis *et al.,* (1994) for the anti-inflammatory and analgesic studies respectively.

The above results therefore show that the traditional use of *Aloe barbadensis* in the treatment of various types of pain and inflammatory conditions has a definite basis.

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