Vol. 3/2 (2003) 161 - 165

JOURNAL OF NATURAL REMEDIES

Biochemical evaluation of the Ulcer curative effect of *Aloe vera* on experimental rats

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Received 22 Octobe 2002 : Revised and accepted 28 March 2003

Abstract

Objective : The present work was aimed to evaluate the curative properties of *Aloe vera* leaf gel on experimentally induced ulcer in rats. Methods : Ethanol was used for the induction of ulcer. An aqueous extract of *Aloe vera* leaf gel was administered orally to ulcer rats. Total number of lesions in the gastric area, total volume, acidity, levels of protein and glycoprotein components were determined in the gastric juice. Results and conclusions : The observed decrease in the number of gastric lesions in the treated rats suggested the cytoprotective and acid regulating properties of the leaf gel.

Key words: *Aloe vera*; ulcer; herbal treatment; acid secretion.

1. Introduction

Aloe vera is a latex containing plant, which belongs to the Liliaceae family [1]. *Aloe barbadensis* is now referred to by taxonomists as *Aloe vera* [2]. The arabic word "Aloeh" means "shining and bitter" [3]. Because the plant is readily adaptable, and because man has been so eager to carry it with him from place to place, it now can be found in many tropical areas. The plant can grow at temperatures as high as 104°F.

The Aloe plant is a succulent perennial and secretes watery juice from tubular cells that run along the length of the fleshy leaves. The mucilaginous tissue in the center of the leaf is called gel. The peripheral bundle sheath cells are intensely bitter and contain yellow latex commonly is termed as Aloe juice or *Aloe vera* sap.

The nomenclature of *Aloe vera* sap and *Aloe vera* gel are often ambiguous. Unlike *Aloe vera* sap, *Aloe vera* gel is colourless and contains no anthraquinones and this gel is responsible for many of its medicinal

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properties, which includes wound healing, anti-inflammatory and anti-microbial [4 - 6]. The clinical use of *Aloe vera* is supported mostly by anecdotal data [7].

With this background, the present study was undertaken to assess the efficacy of *Aloe vera* gel in the treatment of ethanol - induced gastric ulcer in experimental rats.

2. Materials and methods

2.1 Preparation of Aloe vera gel for treatment

Aloe vera powder was prepared from *Aloe vera* gel according to the published procedures [8] with minor modifications. Mature, healthy and fresh leaves of *Aloe vera* having a length of approximately 2 - 3 feet were washed with water. The leaves were cut transversely into pieces. The thick epidermis was selectively removed. The solid jelly-like inner parts were again washed with water thoroughly to remove the *Aloe vera* sap.

These solid gels were cut into small pieces and then homogenized using ethanol. The resulting mucilaginous, thick and straw-colored homogenate was poured into clean ceramic pans as thin layers for quick evaporation and drying. The pans were covered with clean gauze cloth and dried by evaporating in shadow for a week, which yielded 'glossy', 'vitreous' or 'lucid' dark-brownish residue of *Aloe vera.* The residue was ground well into fine powder and stored in dry sterilized small containers and stored at 4ºC until further use.

2.2. Experimental animals

Male Wistar rats weighing about 150-200 g were obtained from Fredrick Institute of Plant Protection and Toxicology (FIPPAT), Padappai, Chennai for the present study. The animals were maintained on Hindustan Lever pellet diet and water *ad libitum.* After 24 h of fasting, with only water provided, 96% ethanol at an oral dosage of 1ml/rat/day was given in three doses at an interval of 72 h to induce ulcer in the experimental animals.

This concentration consistently produced deep erosions, which was employed to assess the occurrence of any healing process by using a dissection microscope [9]. Three days after the administration of the final dose of ethanol, the animals were grouped as follows and each group consisted of six rats:

Group I : Untreated controls

Group II : Ethanol - induced ulcer-suffering rats without treatment

Group III : *Aloe vera* gel treated for 5 days

Group IV : *Aloe vera* gel treated for 10 days

Group V : *Aloe vera* gel treated for 15 days

From the powdered tissues of *Aloe vera*, an aqueous extract containing 250 mg/ml was prepared and 2 ml/rat/day was administered orally in groups III, IV, and V. After the treatment, the rats in all five groups were anaesthetized using ether and the abdomen was opened through a mid-line incision. The pylorus was secured and ligated with silk thread, after which the wound was closed and the animals were allowed to recover from anesthesia [10].

After ligation of the pylorus, drinking water was withheld and the gastric juice was collected for a period of 4 h. The rats were then sacrificed and the stomach was removed after clamping the oesophagus. The gastric juice was collected through the oesophagus and the volume was recorded.

The stomach was then inflated with saline, incised through the greater curvature and examined under a dissection microscope for recording the number of lesions. The experiment was performed under the supervision of a veterinary surgeon.

The total acidity was determined by titrating with 0.01N NaOH using phenolphthalein as indicator. The gastric juice was estimated for the total content of protein [11], hexose and hexosamine [12] and sialic acid [13].

3. Results and discussion

The analysis of chemical composition of *Aloe vera* revealed the presence of various active principles including aloin, aloe – emodin, aloetic acid, resistannol, aminoacids, vitamins, lignins, saponins and salicylic acid, which readily accounts for the medicinal value of *Aloe vera* in many organisms [14 - 17].

From the table 1, it can be observed that the number of lesions in the untreated ulcer group was quite high, and among the treated groups, the group V animals revealed a dramatic decrease in the number of lesions when compared to the animals in the other treated groups.

It is significant to note that the number of lesions in the untreated ulcer group after 15 days remained high. The number of lesions present on the gastric mucosa is an index of the severity of the ulcer [18]. Therefore, the decrease in the number of lesions in the *Aloe vera*-treated groups is a clear indication of the ulcer curative nature of *Aloe vera* gel.

Table 2 represents data on the volume and total acidity of the gastric juice of five experimental groups of animals. It is evident that the volume and total acidity were significantly elevated in the untreated ulcer group relative to the untreated controls. The severity in terms of volume and total acidity showed marked decrease in group V animals when compared to those in groups III and IV.

The increase in volume in the untreated ulcer rats is undoubtedly due to increased production of hydrochloric acid as is evident from the total acidity value of gastric juice. Inauen *et al* [19], have reported that inhibition of acid secretion accelerated ulcer healing. The decrease in volume of the gastric juice and concomitant decrease in the acidity may be attributed to the ulcer healing effect of *Aloe vera* gel.

Table 3 presents data on the content of hexose, hexosamine, sialic acid and total protein in the gastric juice. When compared to the untreated controls, the levels of hexose, hexosamine and sialic acid decreased considerably in the

Table 1
Number of lesions in the gastric area of the rats treated with extracts of *Aloe vera* in different groups

Group	Treatment	Lesion count (n)
I	Untreated controls	——
II	Ulcer controls	8.37 ± 0.22
III	*Aloe vera* for 5 days	6.60 ± 0.28*
IV	*Aloe vera* for 10 days	3.10 ± 0.15*
V	*Aloe vera* for 15 days	1.20 ± 0.12*

Values are expressed as mean ±S.D for six animals in each group; *P< 0.001, group II vs groups III, IV and V

Table 2
Volume and total acidity of the gastric juice of the rats in the different groups

Groups	Volume (ml/100g)	Total acidity (μM equv./4 h)
I	2.23 ± 0.25***	198 ± 15
II	2.87 ± 0.18	239 ± 15#
III	2.74 ± 0.11^{NS}	211 ± 19*
IV	2.65 ± 0.15*	202 ± 14**
V	2.28 ± 0.10***	200 ± 10***

Values are expressed as mean ±S.D for six animals in each group.
NS – Not Significant; *P < 0.05, group II vs groups III and IV; **P < 0.01, group II vs group IV; ***P< 0.001, group II vs group V; #P < 0.001, group I vs group II

Table 3
Levels of hexose, hexosamine, sialic acid and protein in the gastric juice of the rats in the different groups

Groups	Hexose µg/ml	Hexosamine µg/ml	Sialic acid µg/ml	Protein µg/ml
I	390 ± 25 ***	164 ± 18***	36.4 ± 1.9***	270 ± 25
II	310 ± 34	97± 25	23.1 ± 1.4	340 ± 16$^{\#}$
III	324 ± 28^{NS}	121 ± 14^{NS}	25.4 ± 1.1*	315 ± 24^{NS}
IV	358 ± 32*	141 ± 18**	28.7 ± 1.4 ***	298 ± 20**
V	375 ± 28**	161 ± 12***	35.7 ± 1.5 ***	272 ± 21***

Values are expressed as mean ± S.D for six animals in each group.
NS – Not Significant; *P < 0.05, group II vs. groups III and IV; ** P < 0.01, group II vs. groups IV and V; *** P < 0.001, group II vs. groups IV and V; #P < 0.001, group I vs group II

untreated ulcer group of rats, while the protein level was increased. The increase in the level of protein, perhaps, indicated damage to the gastric mucosa as a result of which the proteins accumulated in the gastric juice [20]. The ulcer curative effect of *Aloe vera* gel resulted in progressive increase in the content of hexose in the three treated groups with the amounts reaching near – normal values in rats treated with *Aloe vera* gel for 15 days.

Similar findings have also been observed in the case of sialic acid. A significant rise in the content of hexosamine in rats in groups III, IV and V was observed. The observed decrease in the level of protein with the simultaneous increase in level of glycoprotein moieties in the *Aloe vera* - treated rats indicate a strengthening of the mucosa, thereby, restricting the entrance of proteins into the gastric juice.

Aloe vera can thus be considered as a cytoprotective agent as it appears to strengthen the mucosal barrier, which is considered to be the first line of defense against endogenous and exogenous ulcerogenic agents.

It may be concluded from the present observations that the active principles, which are present in the *Aloe vera* gel, appear to regulate both the acid output and mucous secretion in ethanol-induced ulcers. Thus *Aloe vera* gel can be standardized as a potent herbal medicine in alleviating ethanol-induced ulcer after conducting the requisite clinical trials.

4. Acknowledgement

We acknowledge Life Care Phyto Remedies, Chennai 600 056, for providing the plant materials.

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