ABSTRACT

This study examines the likely activity of *Achyranthes aspera* in the improvement of wound mending. A carrageenan-prompted intense provocative model was utilized to prompt irritation, and an extraction wound model was utilized to make wounds in rodents. Chronic administration of different extracts of *A. aspera*, counting ACAQ (extract aqueous at 200 and 400 mg/kg) and ACME (methyl extract at 200 and 400 mg/kg), initiated for a time of 14 days following injury creation. The application of various extracts of *A. aspera* was observed to have a moderating impact on inflammation and oxidative stress as well as a considerable ameliorating effect on wound healing. Medicinal herbs used for wound healing and skin illnesses are crucial to opening the doors to countering resistance of infections to medicines and allopathic management. Results of antioxidant, anti-inflammatory, and wound healing tests endorse the use of *A. aspera* for dermatological and wound healing purposes, indicating the necessity for additional studies to identify and isolate its active compounds. As demonstrated in carrageenan-induced acute inflammatory and excision wound models, *A. aspera* may, therefore, contribute to the ongoing injuries by diminishing oxidative pressure and incendiary cytokines.

Keywords: Mitigating, Cell reinforcement, Wound, Mending.


Source of support: Nil.

Conflict of interest: None
INTRODUCTION
A dynamic and sophisticated process, including an outpouring of cell and sub-atomic exercises accomplished the restoration of tissue during wound mending. Inadequate wound healing may result in chronic wounds, heightened vulnerability to infections, and protracted inflammation. Traditional medicinal plants have garnered increasing attention as promising reservoirs of innovative therapeutics for wound care in recent times. Among these, Achyranthes aspera therapeutic spice, well established in customary medication frameworks, has arisen as a promising competitor because of its rich history of purpose and episodic proof proposing its viability in injury mending. A. aspera, commonly known as “Prickly chaff flower” or “Aapamarga” in various traditional medicinal systems, has been employed for centuries in different cultures for its diverse therapeutic properties. Recent scientific investigations have shed light on its potential as a natural remedy for wound healing, drawing attention to its anti-inflammatory and antioxidant attributes. A wound’s ability to heal depends on inflammation, yet too much or too long of an inflammatory response could slow down the healing process. The active components found in A. aspera, such as triterpenoids, flavonoids, and alkaloids, are thought to be crucial in its ability to reduce inflammation. By obstructing incendiary pathways, these substances decrease the development of favorable to provocative go between such chemokines and cytokines. By maintaining a stable and regulated inflammatory response, this modulation fosters the best possible conditions for wound healing. Furthermore, the presence of bioactive compounds with antioxidant properties in A. aspera has sparked interest in its potential to mitigate oxidative stress, a factor known to hinder the wound healing process. Oxidative stress not only exacerbates inflammation but also contributes to cellular damage, impairing the overall regenerative capacity of tissues. The antioxidant dynamics of A. aspera add another layer to its therapeutic potential. A. aspera’s rich array of antioxidants, including flavonoids, polyphenols, and ascorbic acid, equips it with the capacity to neutralize ROS, mitigating oxidative stress and its detrimental effects on cellular components. This research article aims to comprehensively explore the potential of A. aspera in wound healing by delving into its anti-inflammatory and antioxidant mechanisms. Through a combination of in-vitro and in-vivo tests, we seek an explication of the molecular pathways involved and evaluate the efficacy of A. aspera in promoting optimal wound repair as we unravel the mysteries of this humble herb, the ability to empower wound-mending outcomes and lessen the burden of chronic wounds beckons. This bodes well for a time when A. aspera reclaims its rightful place in the pantheon of therapeutic interventions.

METHODS AND MATERIALS
Plant Material and Natural Extract Preparation
A. aspera leaves were collected and authenticated by Dr. S. Shweta and Dr. Ashwini Kumar Dixit of Guru Ghasidas Vishwavidhyalya with authentication no. Bot/GGV/2022/20. The leaves were first rinsed with clean water to remove any debris or dirt that had stuck to them and then dried in an oven set to 35 to 40°C. The powder was made by crushing and grinding the dried leaves, and then the powder was weighed. After that, a solution of ethanol and water was used in a sequential fashion for extraction. After collecting and distilling the menstruum under a vacuum, it was air-dried in an evaporating dish until it reached a consistent weight.

Chemicals
The substances that were utilized included carrageenan, diagnostic kits, and analytical grade for all others. The chemicals that were acquired from HiMedia (Mumbai, India) were sodium carbonate, methanol, chloroform, ethanol, thiazolyl blue (MTT), aluminum chloride, and dimethyl sulfoxide (DMSO) of cell culture grade. Sigma (Bangalore, India) provided MSTFA and DPPH (1,1-diphenyl-2-picrylhydrazyl).

Animals
The Institutional Animal Ethics Committee approved the protocols for this investigation, approving protocol number 1355/PO/Re/S/10/CPCSEA. Following the guidelines set out by the CPCSEA, the animals were cared for appropriately. Wistar rats (male) weighing about 180 to 220 g were housed in a standard habitat. The circumstances included keeping a temperature of 23 ± 2°C and a light/dull pattern of 12 hours. The rodents were given standard rat feed and unhindered admittance to new water.

In-vitro Antioxidant Activity
Assay of reducing activity
The components for the concoction included 2.5 mL of sample ranging in concentration from 20 to 320 μg/mL, 2.5 mL of 0.1M sodium phosphate buffer pH of 6.6, and 2.5 mL K2Fe(CN)6 containing 1% by weight. After 20 minutes of incubation at 50°C, the diminishing power was measured in the second step. The following stage is to add 2.5 mL of 10% w/v C2HCl3O2 trichloroacetic acid corrosive and afterward turn the combination at 5000 rpm for 10 minutes. By mixing 4 mL of the top layer at 0.4 mL of fresh FeCl3 (0.1% w/v), the absorbance was calculated at a wavelength 700 nm. To determine the inhibitory concentration (IC50) value, a reference chemical known as ascorbic acid was used. Assay of H2O2 scavenging activity
In this review, a mix of concentrates at fixations somewhere in the range of 20 and 320 μg/mL was blended with 2.5 mL of 0.1M phosphate cradle (pH 7.4) and 600 μL an answer containing 41 mM of H2O2. The mixture was given a good shake and then left to oxidize for ten minutes at room temperature. Next, we took a 230 nm absorbance measurement of the reaction mixture. We utilized virtual reality (VC) to regulate the experiment positively. The procedure for calculating H2O2 scavenging activity is as follows:
Scavenging outcome\% = \left[1 - \left(\frac{A_1 - A_2}{A_0}\right)\right] \times 100

Here, \(A_0\) denotes control absorbance of water, \(A_1\) denotes sample absorbance, and \(A_2\) stands for the sample absorbance alone (instead of \(H_2O_2\) solution, phosphate buffer is taken). Half of a chemical’s \(H_2O_2\) inhibitory impact was at half its susceptibility concentration or its IC\(_{50}\) value.\(^{22-24}\)

Activity of nitric oxide radical scavenging
The action of rummaging nitric oxide was evaluated utilizing the Griess reagent. This included combining 5 mM sodium nitroprusside in phosphate-cushioned saline. Consequently, an answer of the concentration at focuses going from 20 to 320 mg/mL was added to 3.0 mL. Consequently, the blend was kept at a temperature of 25°C for the accompanying 150 minutes. Besides, 5 extra mL Griess reagent containing 1% \(C_6H_8N_2O_2S\), 2% \(H_2PO_4\) and 0.1% naphthalene-diamine dihydrochloride was introduced. To establish a positive control, we carried out identical measurements at 546 nm using ascorbic acid standard solutions prepared with Griess reagent.

With this formula, we were able to determine the inhibition percentage:

\[
\%\text{inhibition} = \left[1 - \left(\frac{A_0 - A_T}{A_0}\right)\right] \times 100
\]

Where when the extract is present, the absorbance is represented by \(A_T\), and when the control is present, it is represented by \(A_0\) (empty, extract-free). For a better picture of the overall picture, we repeated each test three times and analyzed the results graphically.\(^{24,25}\)

TAOC
A variant of the phosphomolybdate technique was expanded upon.\(^{26}\) Initially, a plant sample of 0.3 mL was heated with 1-mg per mL of sugar at 95°C for 10 minutes using 3 mL of phosphomolybdate. It was then decided to measure the absorbance at 695 nm. Afterward, the TAC was determined as milligrams of AAE per gram of raw sample weight by referring to the calibration curve of ascorbic acid (10–320 g/mL).

Assessment of DPPH (1-1-diphenyl 2-picryl hydrayzyl) radical scavenging activity\(^{27}\)
The initial stage involved creating an ethanol solution containing 0.1 mM DPPH. Following that, a blend comprising 1.0 mL of the substance and 3.0 mL of a water-based extract solution, having concentrations from the range 20 to 320 \(\mu\)g/mL, was prepared. Ascorbic acid was used as the reference chemical later 30 minutes when measuring the absorbance at 517 nm. A lower absorption value shows an enhanced capacity to counteract free radicals. This is the equation for the sample’s activity for free radical scavenging DPPH or the percentage of free radical inhibition.

\[
\%\text{inhibition} = \left[1 - \left(\frac{A_0 - A_T}{A_0}\right)\right] \times 100
\]

The presence of absorbance of the extract is represented as \(A_T\), while the absorbance in the absence of the extract is denoted as \(A_0\). We plotted the graph with the mean values after doing all the experiments three times.

Estimation of total phenolic compounds
In this activity, gallic acid was used as a reference phenolic component, and the Folin-Ciocalteau reagent was employed for the estimation process. After following the protocol, the extract solution was measured using a volumetric flask, achieving a concentration of 1-mg/mL. The last response blend comprised 0.5 mL of plant remove arrangement, 2.5 mL of water containing a 5% Folin-Ciocalteau reagent, and 2.5 mL of a fluid arrangement containing 7.5% \(NaHCO_3\). Following a 45-minute incubation at 45°C, the samples were withdrawn. The wavelength at which the blue color was detected was 760 nm. Milligrams per gram of dry extract were used to express the concentration of total phenols. It was necessary to make each determination three times. Milligrams of gallic acid equivalents (GAE) were used to evaluate the total amount of phenolic components in plant extract.\(^{28,29}\)

Estimation Parameters

Acute inflammatory model induced by carrageenan
In order to test the anti-inflammatory activity, the rat paw edema experiment was conducted using carrageenan. A 100 \(\mu\)L subplantar injection of a newly made carrageenan solution in distilled water was administered to each rat in every group (with the exception of Group I) to induce edema. Group II animals were given 20 mg/kg of diclofenac sodium as a single dose 30 minutes before carrageenan injection, while groups III-VII received a single dose of plant extract. The paws were measured at “0 hours,” the time immediately prior to the injection of carrageenan, and again at 1, 2, 4, and 8 hours after the injection. The measurement of paw thickness increase was done by subtracting the paw thickness at “0 hour” from the paw thickness at each hour.\(^{29}\)

Experimental Design
The experimental design for the carrageenan-induced inflammatory model is given in (as shown in Table 1).

Plethysmometer/Paw volume
The inflammatory paw of the rat is placed in the column’s liquid before and after the inflammation-causing procedure, and the weight is then recorded. The formula \(V = m/p\) makes calculating the paw volume a breeze (Here, “\(m\)” stands for the mass of the displaced fluid, “\(p\)” for its density, and “\(v\)” for its volume, which is the same as the paw’s input volume).\(^{30,31}\)

Table 1: Grouping of animals for carrageenan-induced inflammatory model

<table>
<thead>
<tr>
<th>Group No</th>
<th>Group</th>
</tr>
</thead>
<tbody>
<tr>
<td>Group I</td>
<td>Normal control (0.5% carboxymethyl cellulose)</td>
</tr>
<tr>
<td>Group II</td>
<td>Carrageenan control</td>
</tr>
<tr>
<td>Group III</td>
<td>Carrageenan + Standard (Diclofenac Sodium 20mg/kg)</td>
</tr>
<tr>
<td>Group IV</td>
<td>Carrageenan + ACAQ ((A. aspera) aqueous extract 200 mg/kg)</td>
</tr>
<tr>
<td>Group V</td>
<td>Carrageenan + ACAQ ((A. aspera) aqueous extract 400 mg/kg)</td>
</tr>
<tr>
<td>Group VI</td>
<td>Carrageenan + ACME ((A. aspera) methanol extract 200 mg/kg)</td>
</tr>
<tr>
<td>Group VII</td>
<td>Carrageenan + ACME ((A. aspera) methanol extract 400 mg/kg)</td>
</tr>
</tbody>
</table>
Paw Diameter
The paw diameter was measured using the vernier caliper both before and after the injection of carrageenan and medications at 0 hours (1, 2, 4, and 8 hours). By contrasting the control group’s average swelling with that of the test and standard groups, we were able to ascertain the paw diameter inhibition%. The formula used for this calculation is:

\[
\text{Rate Restraint} = \left(\frac{(V1 - V2)}{(V1)}\right) \times 100,
\]

where V1 is the paw diameter prior to injection with carrageenan and V2 is the paw diameter following therapy.\(^{31}\)

Wound Healing Measurement

Excision wounds
After anesthesia, the hairs were removed from the middle region of the dorsal thorax of the rats. To create a wound that was approximately 300 mm\(^2\) in size, the entire designated area was surgically removed. Using an alcohol-soaked cotton swab, the wound was cleansed. Applying the going with condition yielded the percent of wound end:

\[
\text{Percent of closure wound} = 100 \times \left(\frac{(\text{initial area of wound}) - (\text{7th day area of wound})}{(\text{initial area of wound})}\right)
\]

Using GraphPad Prism v8.0, regression analysis was conducted, and a graph depicting the relationship between the percentage of closure of wound and time of closure (measured in days) were generated. When the X value is equal to Y = 50%, the CT50 is the amount of time it takes for the wound to close by 50%.\(^{32}\)

Experimental Design
The experimental design for the carrageenan-induced inflammatory model is given in (Table 2).

Homogenizing Tissue
Collection, rinsing with saline, and homogenization of tissues from various groups took place at 4°C in a 0.1 M Tris-HCl buffer with a pH of 7.4. Following that, homogenates were centrifuged (3000 rpm) for the time period of 10 minutes at 4°C. After that, aliquots were obtained for further analysis. The BSA technique was used to measure the amount of protein in the tissue homogenate.\(^{33}\)

Catalase
After incorporating a detergent, like 1% Triton X-100, into the pH 7 mixture (1:100), the 10% tissue homogenate was reduced using pH-7 phosphate buffer. The method for estimating catalase was reported.\(^ {34}\)

GSH estimation
Mixing 2.5 mL of 5% TCA with 0.5 grams of skin tissue yielded a tissue homogenate. For 10 minutes, the protein that had precipitated was spun in a centrifuge at 1000 rpm. The GSH concentration was estimated using the supernatant (0.1 mL).\(^ {35,36}\)

Lipid Peroxidation Assay
The TCAe-TBA HCl solution was combined with 1-mL of tissue homogenate in each tube, followed by brief vortexing of the tubes in a water bath set to boiling temperature. When the tubes reached room temperature, centrifugation was applied for a duration of 15 minutes. Preceding evaluating the optical thickness (OD) at 535 nm wandered from an undeniable, the supernatants were moved into a cuvette utilizing a pipette.\(^ 36\)

Biochemical Analysis

Estimation of hydroxyproline
The recuperated tissue was extracted and moved to vials for drying in a broiler at 110°C for a term of 48 hours. To assess the hydroxyproline content, 5 mg of freeze-dried material was hydrolyzed with 5 mL of 6N HCl in a tube, which was sealed at 110°C for a duration of 18 to 20 hours, adhering to the specified procedure.\(^ {37}\)

Estimation of collagen
Hydroxyproline concentration can be multiplied by 7.46 to obtain collagen with the same molecular weight.\(^ {37}\)

Estimation of hexosamine
About 5 mg of lyophilized tissue were heated for six to seven hours at 110°C in 5 mL of 2 N HCl. Following vanishing, the buildup was broken up in a foreordained volume of water. The solution was heated to boiling for 15 minutes after adding 1-mL of freshly manufactured 2% acetyl acetone in 1/2 mM of sodium carbonate. Once cooled, 1-mL of Ehrlich’s reagent was mixed with 5 mL of 95% ethanol. The evolution of the purple-red hue was revealed by a spectrophotometric measurement performed at 530 nm for 30 minutes later.\(^ {38-47}\)

Statistical Analysis
The mean ± SEM of the edema volume is displayed, and an ANOVA is performed before Tukey’s post hoc test is utilized to look at the bundle.

(a*): Normal control versus carrageenan control versus wound control
(b*): Wound control vs different doses of plant extract
(***): \(p <0.001\), (**) : \(p <0.01\), (*) : \(p <0.005\)

RESULTS

In-vitro Antioxidants

DPPH free radical scavenging process
The IC\(_{50}\) values for ascorbic acid, ACAQ and ACME were 121.73, 194.3 and 175.05 µg/mL, respectively. The findings

| Table 2: Grouping of animals for excision-induced model |
|-----------------|-----------------|
| Group no | Group |
| Group I | Wound control |
| Group II | Wound + Standard |
| Group III | Wound + ACAQ (A. aspera aqueous extract 200 mg/kg) |
| Group IV | Wound + ACAQ (A. aspera aqueous extract 400 mg/kg) |
| Group V | Wound + ACME (A. aspera methanol extract 200 mg/kg) |
| Group VI | Wound + ACME (A. aspera methanol extract 400 mg/kg) |
demonstrate that the DPPH scavenging activity of both plant extracts is on par with ascorbic acid, the industry standard as shown in Figure 1.

**Reducing power activity**

ACAQ and ACME extracts were tested for their reducing power at various concentrations ranging from 10 to 320 µg/mL. Results showed that ACAQ and ACME extracts had a concentration-dependent increase in their reducing power. At 320 µg/mL, the extracts exhibited the maximum reducing power. With ACAQ, the EC50 was determined to be 23.77 µg/mL. With ACME, it was 26.41 µg/mL, and with ascorbic acid, had 14.72 µg/mL (Figure 2).

**Hydrogen peroxide-scavenging activity**

When tested at a concentration of 320 µg/mL, which was the maximum concentration, the ACAQ extract inhibited hydroxyl radicals by 62.37% and the ACME extract by 64.0%. Ascorbic acid, on the other hand, had a 77.7% inhibition. The extracts demonstrated a concentration-dependent capacity to scavenge these radicals. It was discovered that the IC50 values of the extracts of ACAQ and ACME were 221.10 and 207.4 µg/mL, respectively. The IC50 value of ascorbic acid was determined to be 148.71 µg/mL as shown in Figure 3.

**Total antioxidant capacity (TAC)**

When measured against an ascorbic acid reference standard, ACAQ, ACME displayed potential antioxidant ability, that is 102.43 and 143.9 mg/AAE (Ascorbic acid equivalent), respectively (Figure 4).

**Nitric oxide radical scavenging activity**

The activity to scavenge nitric oxide was measured using a Griess reagent. The initial steps involved dissolving 5 mM sodium nitroprusside in PBS. Next, 3.0 mL of extract varying with concentrations ranging from 20 to 320 µg/mL were subsequently added. A further 150 minutes were spent incubating the mixture at 25°C. There was no evidence of scavenging activity; the ascorbic acid with IC50 value was found to be 152.97 µg/mL, and the ACAQ IC50 value was 203.43 ACME 208.82 µg/mL as shown in Figure 5.
Remedial Ability of Achyranthes aspera in Injury Healing - A Boon

Total phenol content
The ACAQ and ACME extracts had total phenol contents of 500.4, 508.4, and 530.5 mg per gallic acid equivalent (GAE), correspondingly (Figure 6).

Carrageenan-Induced Acute Inflammatory Model

Effect of A. aspera extracts on paw volume
In contrast with the typical rats, the control rats showed an imperative increment ($p < 0.001$) in the volume of their paws following a one-hour treatment of subplantar carrageenan. Individual rats that were given A. aspera (ACAQ, ACME 200 mg/kg and 400 mg per kg) demonstrated a substantial decrease in paw volume starting at 2 hours and increasing with increasing dose ($p < 0.001$, respectively) as it was tally to control rats (Figure 7).

Effect of A. aspera extracts on paw diameter
After one hour of subplantar carrageenan injection, the paw volume of control rats exhibited a notable elevation ($p < 0.001$) compared to that of normal rats. A substantial reduction in paw diameter ($p < 0.001$ respectively) was observed in rats administered with A. aspera (ACAQ, ACME 200 and 400 mg per kg) tally to control rats starting at 2 hours and continuing thereafter (Figure 8).

Wound Contraction
In this study, wounds treated with extracts healed at a considerably faster rate than wounds treated with control or standard. The groups who received extracts showed a statistically significant difference from day seven onwards, and this difference remained until day 14, after the wound had formed (Figures 9 and 10).

Antioxidant Activity in Wound Healing
The levels of glutathione and catalase showed a colossal extension in the social occasion controlled the arrangement stood out from the benchmark bunch. The control group recorded catalase levels at $1.80 \pm 0.04 \mu\text{g/mg}$, while the group receiving standard drugs showed $3.87 \pm 0.11 \mu\text{g/mg}$, and animals treated with ACME at 400 mg per kg showed $3.75 \pm 0.12 \mu\text{g/mg}$ catalase in dry tissue. Glutathione levels measured with the control group, standard drug group, ACAQ at 200 mg/kg, ACAQ at 400 mg/kg, ACME at 200 mg/kg, and ACME at 400 mg/kg groups were observed to be $178.8 \pm 6.34$, $333.16 \pm 5.74$, $253.5 \pm 5.99$, $325.66 \pm 6.11$, $262.33 \pm 4.63$, and $325.5 \pm 11.34 \text{mol/gm}$, respectively. Conversely, the control group exhibited higher tissue MDA values at $254.16 \pm 6.14 \text{U/gm}$. In contrast, the standard drug-treated group recorded $108.66 \pm 4.54 \text{U/gm}$. The ACAQ with 200 mg/kg, ACAQ with 400 mg/kg, ACME at 200 mg/kg, and ACME with 400 mg/kg groups showed $66.16 \pm 2.52$, $97.5 \pm 2.75$, $66.33 \pm 6.20$, and $100.5 \pm 2.87 \text{U/gm}$, respectively, indicating a considerable decrease in MDA levels upon using the formulation ($p < 0.001$) (Figure 11).
Remedial Ability of *Achyranthes aspera* in Injury Healing—A Boon

ACAQ at 400 mg per kg, ACME at 200 mg/kg, and ACME at 400 mg/kg showed hydroxyproline levels of 36.5 ± 1.46, 50.5 ± 1.68, 39.33 ± 0.99, and 52.83 ± 1.81 mg/g of tissue, respectively. The group receiving conventional treatment had tissue hexosamine levels of 21.5 ± 0.96 mg/gm, whereas the control group had values of 6 ± 0.5 mg/gm.

Animals treated with ACAQ at 200 mg/kg, ACAQ at 400 mg/kg, ACME at 200 mg/kg, and ACME at 400 mg/kg exhibited hexosamine levels of 14 ± 1.24, 19 ± 1.31, 14 ± 1.13, and 20 ± 0.85 mg/gm, respectively. There was an existence of a direct correlation between hexosamine and collagen synthesis. In the control group, tissue collagen content was measured at 239.33 ± 3.89 mg/gm, while animals treated with the standard drug showed 366.83 ± 3.37 mg/gm. ACAQ at 200 mg/kg, ACAQ at 400 mg/kg, ACME at 200 mg/kg, and ACME at 400 mg/kg treated groups exhibited collagen levels of 289.83 ± 8.60, 357.33 ± 6.15, 302 ± 9.54, and 361.33 ± 8.37 mg/gm, respectively (as shown in Figure 12).

**DISCUSSION/CONCLUSION**

There are three stages to the healing process of a wound: inflammation, angiogenesis, and collagen deposition. When diverged from the benchmark bunch that sought no treatment, the *A. aspera* isolates showed a quantifiably immense lessening in injury size following 15 days. Collagen plays a critical part in the extracellular lattice, which supports wound recovery. There is a one-to-one relationship between hydroxyproline and collagen production. Contrasted with the benchmark group, animals treated with a polyherbal formulation had considerably higher levels of hydroxyproline in their newly created tissue. Traditional methods for evaluating plant-based wound healing agents rely on invasive and distressing procedures carried out on animal models. The *in-vitro* tests outlined here allow us to screen a plethora of plant compounds for the angiogenic, antioxidant, and cell mobilization characteristics that are crucial to wound healing. This article outlines *in-vitro* assays that can be used to screen herbal preparations for wound healing qualities. According to the results of our research, several extracts (ACAQ 200 mg/kg, ACAQ 400 mg/kg, ACME 200 mg/kg and ACME 400 mg/kg) of *A. aspera* speed up the

**Figure 12: Biochemistry of wound healing: Hydroxyproline, collagen, and hexosamine concentrations**

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mending of wound systems by empowering angiogenesis and fibroblast and keratinocyte assembly.

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