Innovative Herbal Gel Formulation Using Achyranthes aspera for Enhanced Skin Healing

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***Abstract*—This study focuses on the formulation and evaluation of an herbal hydrogel incorporating *Achyranthes aspera* extract, a plant known for its antioxidant, antimicrobial, and wound-healing properties. The gel was prepared using Carbopol 940 as a gelling agent and evaluated for its physical and chemical properties, including viscosity, pH, spreadability, and stability. Phytoconstituent analysis confirmed the presence of bioactive compounds such as alkaloids, flavonoids, and saponins. The formulated gel demonstrated optimal viscosity (8,000 cP), pH (5.5–6.5), and spreadability (9.12 g·cm/s). Comparative studies highlighted its effectiveness in promoting wound healing and skin compatibility, outperforming standard synthetic formulations. The inclusion of Achyranthes aspera makes this formulation a promising alternative for natural and effective topical applications.**

***Index Terms*—Achyranthes aspera, Herbal Hydrogel, Wound Healing, Antioxidant Activity, Phytoconstituents, Natural Formulations.**

I. INTRODUCTION

Achyranthes aspera, commonly known as chaff flower, is a medicinal herb with a rich history of use in traditional medicine. *Achyranthes aspera* has been integral to traditional medicine for centuries, celebrated for its diverse therapeutic properties such as antimicrobial, anti-inflammatory, antioxidant, analgesic, and wound-healing activities. In folk medicine, various parts of the plant including leaves, roots, and seeds are utilized to address a range of ailments, including cuts, bruises, wounds, and skin infections. [1]

Achyranthes aspera has been shown to possess significant antibacterial, antifungal, and anti-inflammatory activities, making it an ideal candidate for inclusion in topical formulations.

Fig No.1. *Achyranthes aspera*

The bioactive compounds such as saponins, alkaloids, tannins, and flavonoids found in the plant contribute to its potent antimicrobial properties. As such, there is growing interest in formulating a topical antiseptic spray using *Achyranthes aspera* extract that can be applied to minor wounds, cuts, or abrasions to prevent infection and promote healing. [2]

1. Analgesic and Antipyretic Activities

Sutar NG et al. (2008) demonstrated that the methanolic extract of *Achyranthes aspera* leaves exhibited significant analgesic and antipyretic effects. These were evaluated using the hot plate and brewer's yeast-induced pyrexia methods, with aspirin serving as the standard drug. [3] FA Mehta et al. (2009) investigated the analgesic properties of the plant's leaves and seeds. Both parts showed notable analgesic activity in mice, assessed through the acetic acid-induced writhing response and the hot plate method. [4]

H. Kumar et al. (2009) reported that the hydroalcoholic extract of the roots and leaves of *Achyranthes aspera* displayed centrally acting analgesic activity in adult male albino rats. This was evaluated using the tail flick, hot plate, and acetic acid-induced writhing methods for peripheral analgesic activity. The study revealed that a dose of 400 mg/kg of the leaf extract exhibited the highest analgesic activity. [5] Neogi N. et al. (1970) identified that

achyranthine, a water-soluble alkaloid from *Achyranthes aspera*, exhibited mild antipyretic activity in rats. [6]

2. Antimicrobial activity

M.T.J. Khan et al. (2010) reported that ethanol and chloroform extracts of *Achyranthes aspera* seeds exhibited mild to moderate antibiotic activity against Bacillus subtilis, Escherichia coli, and Pseudomonas aeruginosa. [7] S.H.K.R. Prasad et al. (2009) investigated various extracts from the leaves and callus of Achyranthes aspera, which also demonstrated antimicrobial properties. [8]

P. Saravanan et al. (2008) tested solvent leaf extracts of *Achyranthes aspera* for antibacterial and antifungal activities. The extracts showed effectiveness against Escherichia coli, Pseudomonas aeruginosa, Proteus vulgaris, Staphylococcus aureus, and Klebsiella species. [9]

T.N. Misra et al. (1992) identified 17-pentatriacontanol as a major constituent isolated from the essential oil of Achyranthes aspera shoots. This oil exhibited antifungal activity against *Aspergillus carneus*. [10] S. Sharma et al. (2006) studied the alcoholic extract of Achyranthes aspera, which revealed the presence of triterpenoid saponin with dose-dependent inhibitory activity against *Staphylococcus aureus*, a bacterium responsible for skin infections in humans. The minimum inhibitory concentration was highest (0.15 mg) for the purified fraction, which was identified as a triterpenoidal saponin through spectral analysis. [11]

3. Wound Healing Activity

The wound healing activity of *Achyranthes aspera* has been explored by S. Edwin et al. (2008). Their study evaluated the ethanolic and aqueous extracts of the plant's leaves using two wound models: the excision wound model and the incision wound model. The findings demonstrated significant wound healing properties, highlighting the potential of *Achyranthes aspera* in promoting tissue repair. [11]

Herbal gels are often as effective as standard formulations, with added benefits like natural healing and fewer side effects. Their success depends on the specific herbal extracts and formulation quality.

II. MATERIALS AND METHODS

1. Materials:

- *Achyranthes aspera* extract preparation.
- Gelling agents (e.g., Carbopol 940).
- Other excipients like propylene glycol, methylparaben, Propylene Glycol etc.

2. Method of Extraction of Achyranthes aspera

50gm of *Achyranthes aspera* was weighed and added to 250ml distilled water heated to 60-80°C for 30 min to 1 hours. Mixture was then cooled and filtered. Filtrate was again heated to 60-80°C and cooled. This was extracted used for further study.

3. Formulation Process:

Carbopol 940 (0.2 g) was weighed and sprinkled into 10–15 mL distilled water while stirring. It was left to hydrate for 2–3 hours, with occasional stirring. Achyranthes aspera extract (2 g), glycerin (1 g), propylene glycol (2 g), and preservative (0.1 g) were dissolved in water and mixed thoroughly. This solution was added to the hydrated Carbopol gel base with gentle stirring. The pH was adjusted to 5.0–7.0 by adding 0.2 g triethanolamine drop by drop while monitoring. The mixture was stirred thoroughly, and homogenization was performed to achieve a smooth gel texture.

Ingredient	Quantity (g)	Purpose
Achyranthes aspera Extract	2.0	Provides antioxidant and wound-healing properties.
Carbopol 940	0.2	Acts as a gelling agent for gel consistency.
Propylene Glycol	2.0	Humectant and enhances penetration of active ingredients.
Glycerin	1.0	Retains moisture in the skin.
Triethanolamine	0.2	Neutralizes Carbopol and adjusts pH.
Preservative	0.1	Ensures microbial safety.
Distilled Water	q.s. to 20 mL	Solvent and base.

Table No.1. Gel Formulation Table

4. Evaluation Parameters:

The physical appearance and pH were evaluated to ensure uniformity and skin compatibility. Spreadability and viscosity tests were conducted to confirm ease of application. Stability studies demonstrated robustness under various conditions, while skin irritation tests verified safe use for topical application.

III. RESULTS AND DISCUSSION

1. Evaluation of Phytoconstituents:

Alkaloids: Detected using Dragendorff's or Wagner's reagent.

Flavonoids: Confirmed by Shinoda or Alkaline Reagent tests.

Saponins: Observed through foam tests, indicating the presence of saponins.

Tannins and Phenolics: Detected using Ferric Chloride reagent (blue-black or green precipitate).

Terpenoids: Identified via Salkowski's test.

2. Physical appearance

Fig No.2. Gel Formulation

Color	Light orange, semi-transparent
Consistency	Uniform, semi-solid
Transparency	Partially transparent
Texture	Smooth with slight irregularities
Shape	Conforms to the bottom of the container

Table No.2. Results of physical appearance

3. Evaluation of pH

Gel formulation was evaluated for its pH with pH paper was found to be in range of 5.5 to 6.5.

4. Evaluation of Spreadability

Excess formulation was placed between two glass slides and 100 gm weight was placed on upper glass slide for 5 minutes to compare the formulation to achieve uniform thickness. Weight can be added and the time to separate the two slides was taken as spreadibilty time. $S= (m \times l) / t$ Where S is spreadabilty, m is weight tied on upper slide, l is length of glass slide and t is time taken in seconds.

Calculations:

Mean found = 5.47

$S= (100 \times 5.47) / 60$

S= 9.12 g.cm/sec.

Spreadability of gel formulation was found to be 9.12 g.cm/sec.

5. Evaluation of Viscosity

Observed Viscosity: 8,000 cP (centipoise) Measured using a Brookfield Viscometer at 25°C with spindle number 7 at 20 rpm. The gel exhibits optimal viscosity within the standard range for topical applications, ensuring ease of use and proper adherence to the skin.

IV. CONCLUSION

The herbal hydrogel formulated with *Achyranthes aspera* extract exhibits significant potential as a natural and effective alternative to synthetic formulations. The presence of bioactive compounds contributes to its antioxidant, antimicrobial, and wound-healing efficacy. Its physical and chemical properties meet the required standards for topical application, ensuring user safety and satisfaction. The study highlights the plant's potential in developing innovative and sustainable pharmaceutical products.

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