International Journal of Pharmacy and Pharmaceutical Research (IJPPR)
Volume 31, Issue 12, December 2025 ijppr.humanjournals.com ISSN: 2349-7203

A Review on Formulation, Evaluation, and Pharmacological Potential of *Achyranthus aspera* Based – Herbal Powder

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Received: 22 October 2025 Revised: 30 October 2025 Accepted: 23 November 2025

ABSTRACT

Achyranthes aspera is commonly known as "prickly chaff flower." Achyranthes aspera (Amaranthaceae) is an important medicinal herb that grows as a weed in India. Although practically all of its parts are employed in traditional medical systems, the seeds, roots, shoots, and leaves are the most important parts that are used medicinally. The plant is thought to be an anti- inflammatory, diuretic, carminative, stomach tonic, and blood purifier. There are proteins, carbohydrates, alkaloids, flavonoids, glycosides, saponins, and tannins. In this work, a polyherbal churna containing A. aspera, Amla, Neem, Turmeric, and Yashtimadhu was constructed and evaluated using pharmacognostical and physicochemical standards.The pharmacological characteristics of Achyranthes aspera include analgesic, immunomodulatory, antioxidant, antibacterial, and anti-inflammatory effects. These diverse effects have drawn the interest of pharmaceutical researchers and medical professionals, making the plant a viable choice for the development of medications and the construction of standardized herbal formulations.

Keywords Achyranthus aspera, polyherbal churna, apamarga , pharmacological action, Medicinal properties.

1. INTRODUCTION

Many plant products are assessed based on their historic applications in the current era of medication development and the identification of novel pharmacological compounds. One of the many plants which are being studied for their therapeutic efficacies is Achyranthes aspera[1]. The synthesis of aromatic compounds, such as beneficial phenols or their oxygen substituted derivatives, is a remarkable skill of plants. Herbal products have grown exponentially worldwide in recent years due to the massive rise in the usage of plant-based health products in both developed and developing nations. Alkaloids, glycosides, tannins, terpenoids, flavonoids, phenol, volatile oils, and many more chemicals are examples of secondary metabolites that are actually useful medicinal agents.[2]The plant's pharmacological actions, which include anti-inflammatory, analgesic, antioxidant, antibacterial, antidiabetic, antihypertensive, and hepatoprotective qualities, are influenced by these ingredients. Achyranthes aspera's therapeutic potential has drawn the interest of contemporary scientists, prompting a number of investigations into its pharmacological effects and prospective medical uses. To fully realize Achyranthes aspera's therapeutic promise, thorough scientific validation of its efficacy and safety is necessary, despite its traditional use and promising pharmacological profile.[11]Aspera is highly responsible for dilation of blood vessels, cardiac depression, blood pressure reduction, and increasing the amplitude and rate of respiration. For therapeutic application, standardization of herbal powder guarantees its efficacy, safety, and purity.

Fig no.1. Achyranthus aspera

2. PLANT DESCRIPTION

2.1 Morphology

- Habit – Wild perennial herb
- Root – Branched tap root
- Stem – Aerial, erect, angular, branched, Hairy, Herbaceous, but woody below.
- Leaf – Opposite, hairy, reticulate venation
- Fruit – And indehiscent achene enclosed within persistent perianth

2.2 Biological source

The Amaranthaceae family includes the well-known traditional herb Achyranthes aspera. [11]

2.3 Geographical Source

In India, it thrives as a weed up to 2100 meters above sea level on the sides of roads, field borders, and waste areas. Additionally, Australia, Bangladesh, the South Andaman Islands, America, Baluchistan, Ceylon, Africa, and Tropical Asia are home to it.[1]

2.4 Taxonomic classification(6,1).

Kingdom: Plantae	Subkingdom: Tracheobinota
Super Division: Spermatophyta	Division: Mangoliophyta
Class: Mangoliophsida	Subclass: Caryophyllidae
Order: Caryophyllales	Family: Amaranthaceae
Genus: Achyranthes	Species: aspera

2.5 Botanical description:

- Synonyms
- Latin – Achyranthes aspera
- Sanskrit – Aghata
- Hindi – Latjira, Chirchira
- Gujarati – Safad Aghedo
- Tamil – Shiru-kadaladi
- Telugu – Uttaraene
- Malayalam – Kadaladi
- Punjabi – Kutri
- Unani – Chirchitaa

- Ayurvedic – Apaamaarga, Chirchitaa, Shikhari, Shaikharika
- Persian – Khare-vazhun
- Arabian – Atkumah
- French – Achyranth a feuilles rudes, collant, gendarme
- Spanish – Mosotillo, rabo de gato, rabo de chango, rabo de raton[1]

3. TRADITIONAL & ETHNOMEDICINAL USES OF ACHYRANTHUS

ASPERA Ayurveda, Siddha, and traditional medicine all make extensive use of Achyranthus aspera (Apamarga). Because of its detoxifying, analgesic, antibacterial, and diuretic qualities, it has historically been used to treat inflammation, wound healing, arthritis, skin illnesses, cough, asthma, renal disorders, fever, hemorrhoids, and infections. [25,4]

4. RATIONALE FOR DEVELOPING ACHYRANTHUS ASPERA–BASED HERBAL POWDER .

Because of bioactive components such saponins, flavonoids, phenolics, and alkaloids, Achyranthus aspera has strong anti-inflammatory, analgesic, antibacterial, antioxidant, and wound-healing properties.[26] Better stability, ease of administration, increased patient compliance, and synergistic benefit when paired with supportive herbs for greater therapeutic action make herbal powder (Churna) an appropriate dosage form.[25]It is therefore scientifically justified to create a herbal powder based on A. aspera for the treatment of infectious and inflammatory diseases.

5. HISTORY AND ORIGIN

Ayurvedic and Chinese medicines mention two types of A. aspera: red and white. Sanskrit names describe Achyranthes aspera as having a rough flowered stalk. According to “Nighantas,” it is pungent, purgative, digestive, and a treatment for internal organ inflammation, itching, piles, swollen cervical glands, and abdominal enlargements. The diuretic characteristic of Both Indian locals and European physicians were familiar with the plant. Many indigenous prescriptions included a variety of plant components as medicines in addition to more potent treatments. In Baluchistan, Ceylon, Tropical Asia, Africa, Australia, and America, the plant is used as a medicinal weed. In northern Bangladesh, it is described as an invasive alien species. Additionally, it is the most common weed in Shivbari, Himachal Pradesh, and an exotic medicinal herb in the region of Lalitpur, Uttar Pradesh, India.[17] A. aspera is a medicinal herb that can be found in waste areas, road sides, and field boundaries all over India. [24]

6. PHARMACOLOGICAL ACTIVITY

Achyranthes aspera is a good candidate for a variety of therapeutic uses due to its broad spectrum of pharmacological activity. Some of the noteworthy pharmacological actions of Achyranthes aspera that have been investigated are listed below.

Anti-inflammatory Activity

Achyranthes aspera has long been used to treat inflammatory diseases, and research has shown that it contains anti-inflammatory qualities. By blocking pro-inflammatory mediators and cytokines, the plant's bioactive substances, including flavonoids, alkaloids, and saponins, help to lower inflammation.[4,8]

Analgesic and Antinociceptive Effects

Achyranthes aspera has been shown to have analgesic qualities, which reduce pain. The substances in the plant block the perception and transmission of pain by acting on the central and peripheral nerve systems.[4]

Antioxidant Activity

Achyranthes aspera's strong antioxidant activity is attributed to the presence of flavonoids and phenolic chemicals. By neutralizing oxidative stress, scavenging free radicals, and shielding cells from harm, it may be able to prevent a number of chronic illnesses linked to oxidative damage.

Antibacterial Properties

Achyranthes aspera has demonstrated strong antibacterial action against a range of viruses, bacteria, and fungi. The potential of the plant's components and extracts as natural remedies for microbial illnesses has been investigated.[4]

Wound Healing

Scientific research supports the traditional application of Achyranthes aspera for wound healing. By encouraging angiogenesis, collagen synthesis, and cell proliferation, the plant's extracts have been demonstrated to hasten the healing of wounds.[4]

Immunomodulatory Effects

Achyranthes aspera influences the immunological response through immunomodulatory activities. It may help manage a variety of immunological illnesses by strengthening the body's immune defenses.[4]

Antidiabetic Activity

According to certain research, extracts from Achyranthes aspera have hypoglycemic qualities, which may aid in the treatment of diabetes by controlling blood sugar levels.[4]

Hepatoprotective Effects

The plant has been studied for its capacity to protect the liver against oxidative stress and a variety of toxins.[4,8]

Anti cancer property

Preliminary investigations have suggested that Achyranthes aspera extracts may have anticancer activity and may be employed in cancer therapy, however further research is required. [4]

Antihypertensive Activity

According to certain research, Achyranthes aspera may have antihypertensive properties, which may contribute to its potential use in the treatment of hypertension. [4,8]

Blood Sugar Regulation

Achyranthes aspera has been used in some traditional treatments to help control blood sugar levels and manage diabetes.

Immune System Support

Achyranthes aspera has been traditionally used to boost the immune system and enhance the body's ability to defend against infections.

7. THE PHYTOCHEMISTRY OF ACHYRANTHES

The study of Achyranthes aspera's chemical makeup and the identification of its bioactive components are referred to as phytochemistry. Achyranthes aspera contains a number of significant classes of bioactive chemicals, including:

1) Alkaloids It is known that Achyranthes aspera contains a number of alkaloids, including betaine, ecdysterone, ecdysone, and achyranthine. Nitrogenous substances known as alkaloids frequently display pharmacological properties including analgesic and anti-inflammatory actions.[4]

2) Flavonoids Plants are rich in flavonoids, a broad class of polyphenolic chemicals. Quercetin, rutin, kaempferol, and apigenin are among the flavonoids found in Achyranthes aspera. Flavonoids are linked to a number of health advantages and have antibacterial, anti-inflammatory, and antioxidant qualities.

3) Saponins when shaken with water, saponins, which are glycosides, can create a soapy foam. Saponins found in Achyranthes

aspera have been shown to have a variety of pharmacological actions, such as immunomodulatory, anti-inflammatory, and antibacterial properties.

4) Triterpenoids Often present in plant extracts, triterpenoids are a class of chemicals that are produced from isoprene units. Triterpenoid chemicals found in Achyranthes aspera may help explain its anti-inflammatory and antioxidant qualities.

5) Phenolic Compounds Achyranthes aspera is rich in phenolic compounds, such as tannins and phenolic acids. These substances can shield cells from oxidative damage because of their antioxidant properties.

6) Sterols β-sitosterol and stigmasterol are among the sterols found in Achyranthes aspera. These substances have been linked to a number of pharmacological activities, such as immunomodulatory and anti-inflammatory properties.

Table: Major Phytochemicals and Plant Part Source[26,24]

Phytochemical class	Specific Compounds Reported	Plant Part Source	Therapeutic Relevance
Saponins	Oleanolic acid saponins, Agyrosides	Whole plant, root	Anti-inflammatory, analgesic
Flavonoids	Quercetin, Kaempferol	Leaves, stem	Antioxidant, antimicrobial
Alkaloids	Achyranthine, Betaine	Seeds, root	Antihypertensive, CNS effects
Steroids	B-Sitosterol, Stigmasterol	Whole plant	Anti-inflammatory
Terpenoids	Oleanolic acid, Ecdysterone	Root, leaves	Wound healing, anti-arthritic
Glycosides	Phenolic and cardiac glycosides	Leaves	Cardioprotective, antioxidant
Phenolics & Tannins	Gallic acid, Tannic acid	Aerial parts	Astringent, antimicrobial

8. FORMULATION APPROACHES OF HERBAL POWDER

8.1 Ingredients used in extract Powder churna.

Achyranthus aspera extract powder	50%
Neem leaf powder	10%
Turmeric powder	10%
Amla	20%
Yastimadhu	10%

Fig.no:2 Herbal Ingredients

8.2 Collection and preparation of extract of Achyranthus aspera leaves

1. fresh leaves of Achyranthus aspera was collected.

2. leaves were washed and dried under shade for 1 week.

3. Dried leaves were pulverized to obtain fine powder.

4. Aqueous extract of powder leaves was obtained using soxlet assembly.

5. Filter the extract and allowed to evaporate on water bath.

6. then obtain fine powder of Achyranthus aspera.

7. Phytochemical analysis/ formulation.[15]

8.3 Formulation

1) Collect and authenticate all raw herbal ingredients.

2) wash and shade dry all herbs separately.

3) pulverized each ingredient into fine powder using a mechanical grinder.

4) Seive through mesh no.80 to get uniform particle size.

5) mix all powder in equal proportions to form a homogeneous blend.

6) store in airtight amber coloured glass container to protect from moisture and light.

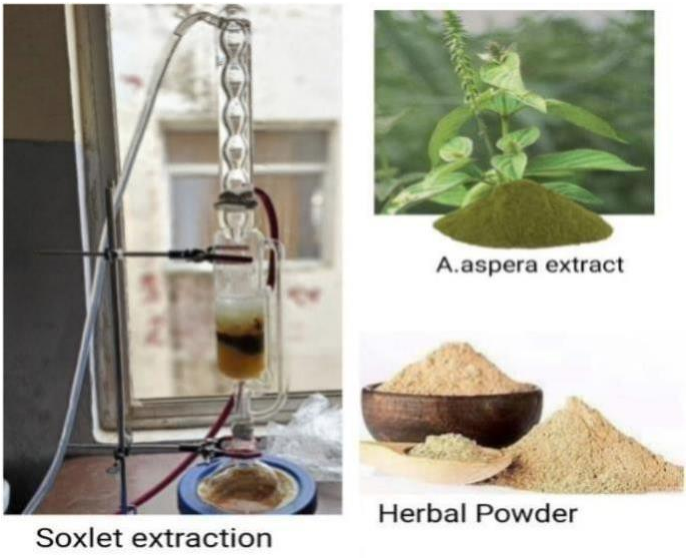

Fig no.3.

8.4 Uses of apamarga churna :-Promotes Healthy Urination Supports Healthy Digestion & Appetite Promotes Healthy Urination , Relieve dysuria, ascites, liver and spleen disorders, ear diseases and leukoderma, cold, cough other respiratory diseases treatment.[2]

9. EVALUATION PARAMETER OF HERBAL POWER

9.1 Physical Evaluation

1. Determination of Moisture Content two grams of each sample were put into a flat porcelain dish that had been previously weighed. Dry in an oven at 100°C +/- 5°C until the weight remains consistent. The weight loss was computed using air-dried material as a reference.

2. Determination of Total Ash Content Two grams of air-dried powder were evenly layered in a silica crucible, ignited gradually up to 500–600 degrees Celsius until it turned white, signifying the absence of carbon, allowed to cool, and then weighed to calculate the percentage of ash in relation to the corresponding air-dried samples.

3. Determination of Acid Insoluble Ash Content After boiling the ash with diluted HCL for five minutes, the insoluble material was collected in a sintered glass crucible, which was then cleaned, ignited, cooled, and weighed to determine the percentage of acid-insoluble ash relative to the bone- dried material.

4. Determination of Water Soluble Ash Content After boiling the total ash with water for five minutes, the insoluble ash was gathered in a glass crucible that had been sintered and burned at a temperature of no more than 450 degrees Celsius. To determine the amount of water-soluble ash in relation to the bone-dried medication, cool and weigh.

5. Determination of Solvent Extractive Values 5 grams of the powdered, air-dried material were macerated with 100 milliliters of solvent, shook repeatedly, and left for a full day. After that, the filtrate was filtered, evaporated, dried, and weighed. It is necessary to compute the proportion of solvent soluble extractive in relation to the bone-dried sample.[15]

9.2 Chemical Evaluation

1) Test for Saponins

Foam test Samples were thoroughly shaken after being dissolved in distilled water. The presence of saponins in the sample is indicated by the formation of a stable layer of foam on the top layer.[15]

2) Test for Flavonoids

NaOH Test After adding 10 milliliters of 1% NaOH solution to 1 milliliter of the sample and carefully shaking it, a yellow hue was seen, indicating the presence of flavonoids.[15]

3) Test for Glycosides

Hansch Test When concentrated H2SO4 was added to an aqueous extract from the side walls, a brown ring formed, indicating the presence of carbohydrates.[15]

4) Test for Proteins

Xanthoprotein Test Combine 3 ml of extract solution with 1 ml of concentrated H2SO4, then boil the mixture to produce a yellow precipitate that indicates the presence of proteins.[15]

5) Test of terpenoids

Salkowski test : Salkowski examination A test tube was filled with 0.1g of plant extract. One milliliter of chloroform and one milliliter of concentrated sulfuric acid were introduced from the test tube's side. If terpenoid is present, the chloroform layer turns red.[23]

6) Test of alkaloids

Mayer's test: Mayer's examination After stirring 0.5 g of extract with 5 ml of 1% HCl in a steam bath, the liquid was filtered. A few drops of Mayer's reagent were added to one milliliter of filtrate. Alkaloids are indicated by white or creamy white precipitate. [23]

Wagner's test Wagner's examination In a steam bath, 0.5 g of extract was mixed with 5 ml of 1% HCl and filtered. A few drops of Wagner's reagent were added to one milliliter of filtrate. Alkaloids are indicated by a dark or deep brown precipitate. [23]

Hager's test The Hager test In a steam bath, 0.5 g of extract was mixed with 5 ml of 1% HCl and filtered. A few drops of Hanger's reagent were added to one milliliter of filtrate. Alkaloids are indicated by yellow crystalline precipitate.[23]

7) Test of steroid

Libermann-Burchard's test The Libermann-Burchard test for steroids One milliliter of chloroform was added to a test tube containing a tiny amount of plant extract (0.1 grams). One milliliter of strong sulfuric acid was added after two milliliters of acetic anhydride. The formation of a greenish hue indicated the presence of steroids. [23]

Fig.no:4 Chemical Test

9.3 Organoleptic Properties Parameter Observation

Color	Greenish-brown
Odor	Characteristic
Taste	Bitter, astringent
Appearance	Fine, free-flowing powder

9.4 Physicochemical Parameters

Parameter	**Result**
Loss on Drying (LOD)	Not more than 5%
Total Ash	Not more than 10%
Acid-Insoluble Ash	Not more than 1%
Water Soluble Extractive	20–25%
Alcohol Soluble Extractive	15–20%

(Ref: Ayurvedic Pharmacopoeia of India, Vol. I)

9.5 Flow Properties

Test	**Result**
Bulk Density	0.52 g/cm³
Tapped Density	0.64 g/cm³
Carr's Index	18.75% (Fair flow)
Hausner Ratio	1.23
Angle of Repose	29° (Good flowability)

9.6 Preliminary Phytochemical Screening

Alkaloids	Present
Saponins	Present
Flavonoids	Present
Tannins	Present
Steroids & Terpenoids	Present
Phenolic compounds	Present

(Ref: Kokate C.K. "Practical Pharmacognosy", 4th Ed.)

10. HERBAL POWDER DEFINITION, ADVANTAGES AND DISADVANTAGES

10.1 Definition Herbal powder

It is made by drying, crushing, and sifting dried medicinal plant material (such as leaves, roots, seeds, bark, or the entire plant) to create a uniform, free flowing powder.

It can be taken directly, with water, honey, or ghee, and is used for medicinal, nutritional, or preventive health purpose of Herbal Powder.

10.2 Advantages: 1. Simple drying and grinding procedures make preparation simple.

2. Economical: Less expensive than extracts, pills, or capsules.

3. Quick absorption: The body acts more quickly thanks to fine particles.

4. Adaptable dosage: It can be taken as churna, along with food, water, honey, or ghee.

5. Long shelf life: Powders stay stable when stored correctly.

10.3 Disadvantages:

1. Unpleasant taste or smell: A lot of herbs have a strong, bitter fragrance.

2. Bulkier dose: Needs more than pills or extracts.

3. Moisture-sensitive: If improperly stored, it may spoil or lump.

11. CLINICAL AND COMMERCIAL SCOPE

1. Possible Dosage Forms

Potential Dosage Types Achyranthus aspera-containing herbal powders can be made into Churna (traditional powder), capsules, pills, and sachets to improve patient compliance, stability, and dose accuracy.

2. Market Potential

Potential Market India is one of the main producers and exporters of herbal products, and the desire for safe, natural, and affordable treatments is driving the growth of the worldwide herbal medicine market.

3. Therapeutic Demand

Demand for Therapy Because of its anti-inflammatory, antibacterial, wound-healing, antidiabetic, hepatoprotective, and antioxidant qualities, the formulation has excellent therapeutic promise and supports the high demand in pain treatment, skin care, immunity boosting, and lifestyle diseases.

12. FUTURE PERSPECTIVES

Pharmacological Validation: To confirm the pharmacological effects of Achyranthes aspera seen in conventional medicine, more investigation is required.

Mechanistic Studies: Developing targeted treatments requires an understanding of the underlying mechanisms of Achyranthes aspera's pharmacological activities.

Drug Development: New medications or therapeutic agents for a range of illnesses may be developed as a result of the identification and isolation of bioactive chemicals from Achyranthes aspera. In this quest, cooperation between practitioners of traditional medicine and contemporary pharmaceutical researchers is essential.

Formulation Development: Achyranthes aspera's clinical value can be increased by creating standardized herbal formulations, extracts, or phytopharmaceuticals.

13. RESULTS AND DISCUSSION

Studies show that Achyranthes aspera powder has good physicochemical quality, low moisture, and stable flow properties. Literature reports confirm strong pharmacological activities such as anti-inflammatory, antidiabetic, antimicrobial, and wound-healing effects. These results support its traditional medicinal use, though more standardization and clinical studies are still needed.

14. CONCLUSION

Rich phytochemical content, including saponins, flavonoids, alkaloids, and terpenoids, supports the anti-inflammatory, antimicrobial, antioxidant, wound-healing, hepatoprotective, and antidiabetic properties of Achyranthus aspera-based herbal powder. The composition can be modified into churna, pills, and sachets to improve patient compliance and commercial viability. It provides promise benefits as a safe and economical polyherbal therapy. Despite its potential, there are still obstacles to overcome, such as the absence of standardized phytochemical markers, a dearth of clinical studies, inadequate toxicity profiling, and problems with formulation stability. To guarantee the herbal powder formulation's widespread acceptance and therapeutic dependability, future studies should prioritize clinical validation, safety evaluation, improved formulation optimization, and regulatory standardization.

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How to cite this article:
Ms. Pallavi A. Gavade et al. Ijppr.Human, 2025; Vol. 31 (12): 195-205

Conflict of Interest Statement: All authors have nothing else to disclose.