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Achyranthes aspera (Latjeera): Ethnomedicinal usage and chemical components

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Abstract
Medicinal plants have been used as a source of medicine since prehistoric times. They have always held a prominent position at the forefront of all cultures and throughout human history. They are a rich source of phytochemicals, and it is through these phytochemicals that many contemporary medicines have been developed. The Amaranthaceous family includes the herbaceous perennial plant known as *Achyranthes aspera*, which stands upright. *A. Aspera* is a plant that has a bitter taste and is made up of secondary metabolites such as alkaloids, saponins, tannins, flavonoids, glycosides, steroids, essential oils, and fatty acids. These secondary metabolites are vital in demonstrating improved bioactivity against several ailments. The phytoconstituents can be found in many different sections, including the seeds, the roots, the shoots, and the leaves. This review highlights *A. Aspera* many secondary metabolites and their potential for therapeutic medications.

Keywords: Latjeera, therapeutic, benefits, hentriacontane, *Achyranthes aspera*, pharmacological activities, antimicrobial medicinal plants, Antibiotics

1. Introduction
According to the World Health Organization (WHO), around 80% of the population in underdeveloped nations relies nearly entirely on traditional medicine for their primary healthcare requirements. Traditional remedies have a long history in India, and people have used them for millennia. Conventional medicine is divided into three primary systems: Ayurveda, Unani, and Siddha. Medicinal plants are essential in practically every system and are the foundation of traditional medicine [1]. About 2000 medications of natural origin are included in the Indian Materia Medica, practically all of which are derived from various ancient systems and cultural practices. Most of these traditional systemic medications are of vegetable origin (Nadkarni, 1976; Anonymous, 2004; Sharma *et al*., 2000). Standardization is evaluating the quality and purity of crude medications using numerous characteristics such as morphological, microscopical, physical, chemical, and biological observation. Standardisation is required for herbal medicines to evaluate their quality using pharmacognostic, phytochemical, and biological principles. Traditional medicines have always been essential in Indian communities. However, only approximately 10% of the more than 250,000 species of higher plants have been properly studied. As a result, adequate quality control systems for herbal medications must be developed [2, 3]. Pharmacognostic studies aid in plant identification and authentication. Appropriate identification and quality assurance of the beginning materials are required to ensure the reproducible quality of herbal medicines, contributing to their safety and efficacy. *Achyranthes aspera* Linn. Belongs to the Amaranthaceae family and is found in tropical, subtropical, and warmer regions worldwide. The name Achyranthes is derived from the Greek words aca chyron chaff, and anthos, flower, and refers to the blossom's chaffy components. It is a 1-2 m-tall erect or procumbent annual or perennial herb with a woody base that is usually found along roadsides. Most authors associate the drug with *Achyranthes aspera* Linn. (Amaranthaceae), which fits with the term apamarga because its fruiting spikes with barbed prickles attach to human clothing and the bodies of passing animals [3-6]. *Achyranthes aspera* Linn is a well-known medicinal herb in several Indian medical systems.

It is bitter, pungent, hot, laxative, stomachic, carminative, and beneficial in treating vomiting, bronchitis, heart disorders, piles, abdominal aches, ascites, dyspepsia, and indigestion [1, 3].

2. Geographical Origin

In India, up to an altitude of 2100 meters, including in the South Andaman Islands, it is a weed that can be seen growing along roadsides, field boundaries, and waste locations. In addition to these regions, the plant is common in Baluchistan, Ceylon, Tropical Asia, Africa, Australia, and the Americas.

Fig 1: Latjeera (*Achyranthes aspera* L.)

3. Morphology

The herb known as latjeera (*Achyranthes aspera* L.), which can grow upright or procumbent, annually or perennially, can reach heights of 1-2 meters and frequently has a woody base. Stems angular, ribbed, simple, or branched from the ground, often with a tinge of purple color [8], branches terete or quadrangular, striate, pubescent, leaves thick, 3.8–6.3 22.5–4.5 cm, ovate–elliptic or obviate–rounded, finely and softly pubescent on both sides, entire, petiolate, and patio 6–20 mm in length, blooms greenish white, numerous in auxiliary or terminal spikes up to 75 cm in length, seeds subcylindrical, truncate at the apex, rounded at the base, and reddish brown in appearance [4, 5].

4. Taxonomic classification

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

5. Ethno-pharmacology: *Achyranthes aspera* has been used in traditional and folk medicine to treat various diseases. Ethnopharmacological claims revealed that *A. Aspera* had been used to treat various ailments since ancient times. Many countries employ it in their traditional medical systems. In India, it treats asthma, abdominal Tumours, haemorrhoids, gynaecological diseases, ophthalmia, odontalgia, snake bites, and wound healing. It is used to treat skin injuries and abdominal tumours in Bangladesh. In Kenya, it is also used to treat malaria symptoms. It is used in Sri Lanka and Pakistan to treat cardiac, oedema, dermatological diseases, diabetes mellitus, and renal oedema. In South Korea, *A. Aspera* treats arthritis, contraception, delayed menstruation, induced absorption, and osteoarthritis [6, 8].

5.1 Alkaloids

The ethanolic extract of *A. Aspera* leaves was used to identify achyranthine and betaine alkaloids [4, 6]. 27-cyclohexyheptacosan-7-ol, 16-hydroxy-26-methyl heptacosan-2-one, and 4-pentatriacontanol were extracted from *A. Aspera* leaf extracts using hexane, chloroform, ethyl acetate, and methanol extracts. Isobetanin and betanin were extracted using methanol and water (9:1), followed by HPLC analysis [4]. Cuscohygrine was isolated from the leaves, roots, and stem of *A. Aspera* using ethyl acetate, acetone, ethanol, and methanol extracts [4]. Figure 1 depicts the structures of *A. Aspera* alkaloids.

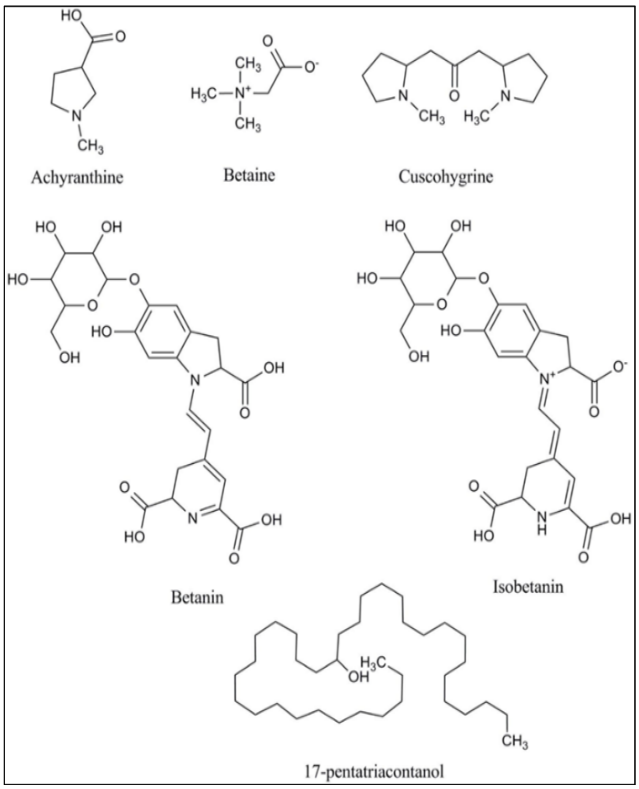

Fig 2: Structures of alkaloids from *A. Aspera* [4]

5.2. Flavonoids

Eupatorine was detected utilising several extracts, including ethyl acetate, acetone, ethanol, and methanol [4]. Narayan and colleagues isolated chrysin, quercetin, and kaempferol from the plant's aqueous extract. 6-prenyl apigenin, a bioactive flavonoid derived from the ethyl acetate fraction of *A. Aspera* seeds [8, 9]. Taxifolin and isoflavone genistein were extracted from the methanolic extract [2]. TLC was used to identify quercetin-3-O-D-galactopyranoside,

followed by HPTLC using methanol and water extract [2]. Using dichloromethane and ethyl acetate fractions, rutin, kaempferol-3-O-glucoside, isoquercetin, apigenin-7-O-hexuronide-4'-O-rhamnoside, kaempferol-3-O-neohesperidoside, kaempferol-3-O-rutinoside, and tiliroside were isolated [2]. Quercetin was isolated using a methanolic preparation of *A. Aspera* leaves and roots [3, 8]. Figure 2 shows the structures of flavonoids.

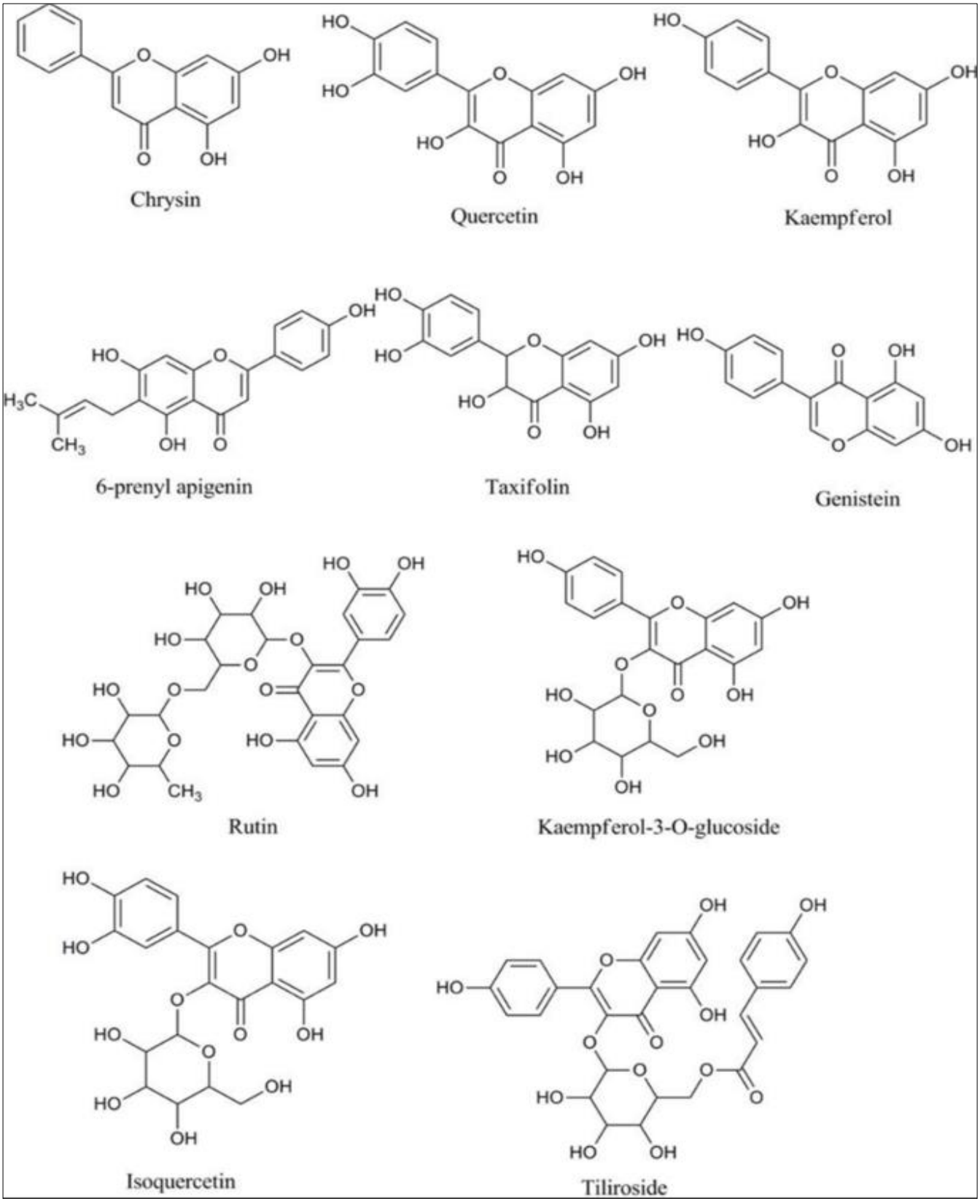

Fig 3: Structures of flavonoids from *A. Aspera* [4]

5.3 Saponins

A. Aspera leaves and roots aqueous extract contained bisdesmosidic saponin. The methanolic extract of *A. Aspera* contained β-D-glucopyranosyl 3-(O-β-D-glucopyranosyl oxy)-oleanolate and β-D-galactopyranosyl (1→2)-oleanolate [9]. Chikusetsu saponin-IV, a butyl ester, zingibroside R1,

bidentatoside, bidentatoside II, and momordin Ib were recovered from the aqueous and acetonitrile extracts of *A. Aspera*. Gas chromatography and mass spectroscopy revealed sapogenin [4]. Fig. 3 shows *A. Aspera* saponin structures.

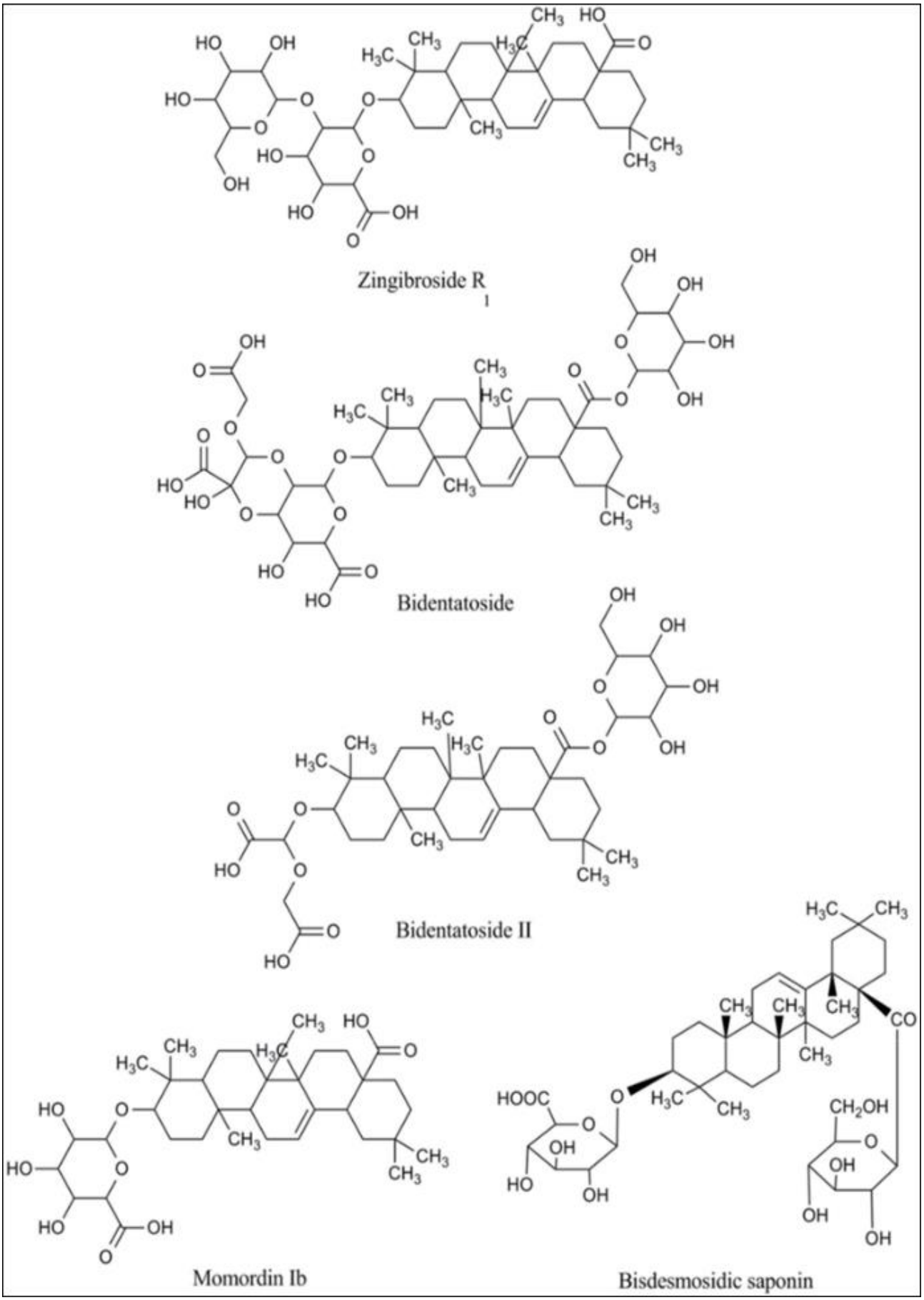

Fig 4: Structures of saponins from *A. Aspera* [4]

5.4 Terpenoids and Steroids

Hexane, chloroform, ethyl acetate, and methanol extracts of *A. Aspera* leaves identified β-sitosterol and spinasterol [5]. *A. Aspera* extract included 6b, 11b, 16a, 4a, 21-pentahydroxy pregna-1, 4-diene-3, 20 dione 16, 4-acetonide (terpene), 3-Deoxy-3-azido -25-hydroxyvitamin D3 (secosteroid), and 3-Hydroxy lidocaine glucuronide (steroid) [4]. *A. Aspera* leaf and root aqueous solutions yielded an ecdysterone [24]. *A. Aspera* extracts included beta-ecdysone, 20, 26-dihydroxyecdysone, stachysterone D, (25S)-20, 22-O-(Rethylidene) inokosterone, and (25S)-inokosterone-20, 22-acetonide. *A. Aspera* produced nerol, spathulenol, spinasterol, β-sitosterol, and ecdysone. Using toluene, ethyl acetate, and formic acid (9:1:0.1), HPLC identified β-sitosterol and lupeol. Achyrantheric, corrosolic, and ursolic acids were extracted from petroleum ether. 20-ydroxyecdysone was extracted from methanol [4, 11]. Fig. 4 depicts *A. Aspera* terpenoids and steroids.

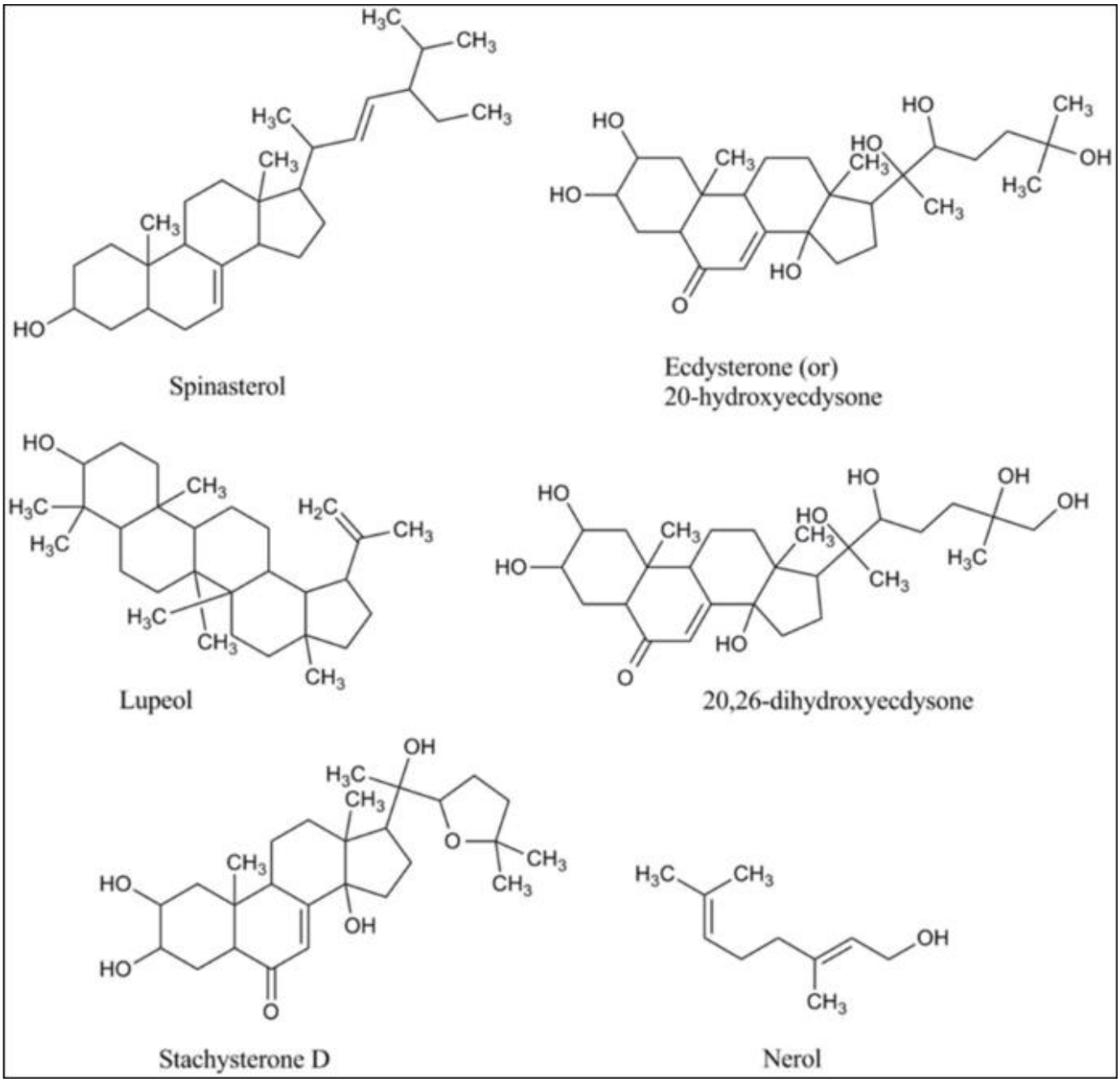

Fig 5: Structures of terpenoids and steroids from *A. Aspera*

5.5 Phenolic substances

Gallic, vanillic, ferulic, isoferulic, protocatechuic, syringic, salicylic, gentisic, p-coumaric, trans-cinnamic, p-hydroxybenzoic, chlorogenic, sinapic, and caffeic acids were found in *A. Aspera* extracts [2]. Other phenolic compounds, such as protocatechuic acid, salicylic acid-O-hexoside, chlorogenic (5-caffeoylquinic) acid, 4-caffeoyl quinic acid, 4, 5, 3, 5, and 3, 4, 5-tri caffeoyl quinic acid, were extracted and identified [2]. *A. Aspera* methanol extract yielded methyl caffeate [5]. Behenic and myristic acids were found [2]. *A. Aspera* contains phenylpropanoid asaron [4]. Proanthocyanidin was isolated from *A. Aspera* roots and inflorescences using petroleum ether, benzene, chloroform, ethyl acetate, ethanol, and water [4, 12]. Fig. 5 shows phenolic compound structures.

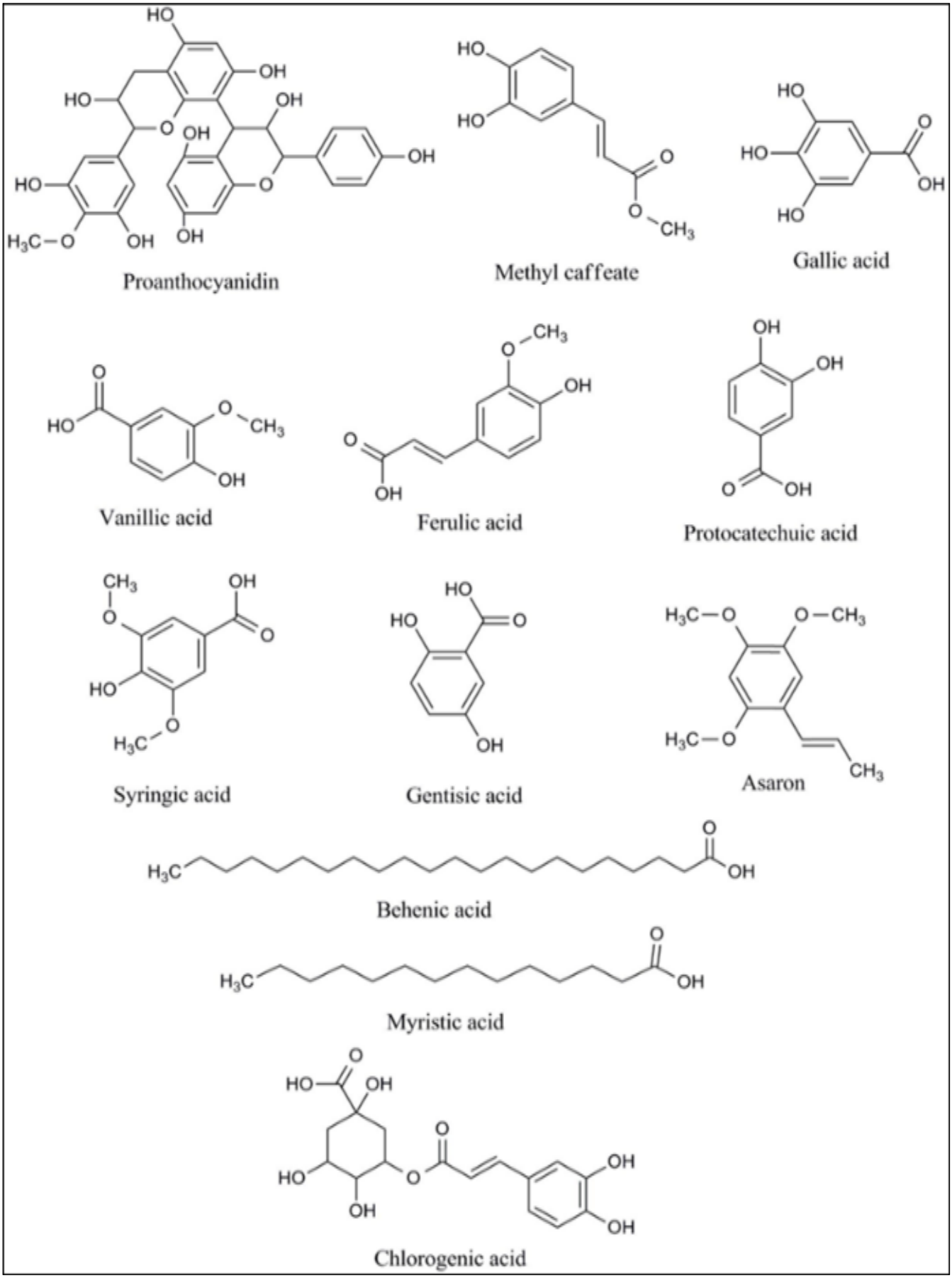

Fig 6: Structures of phenolic compound from *A. Aspera*

5.6. Phenolic compounds

Phenolic acids namely gallic acid, vanillic acid, ferulic acid, isoferulic acid, protocatechuic acid, syringic acid, salicylic acid, gentisic acid, p-coumaric acid, trans-cinnamic acid, p-hydroxybenzoic acid, chlorogenic acid, sinapic acid and caffeic acid were identified from various extracts of *A.*

Aspera [20]. Other phenolic compounds, namely protocatechuic acid, salicylic acid-O-hexoside, chlorogenic (5-caffeoylquinic) acid, 4-caffeoyl quinic acid, 4, 5-dicaffeoyl quinic acid, 3, 5-dicaffeoyl quinic acid and 3, 4, 5-tricaffeoyl quinic acid were isolated and identified [4]. Methyl caffeate was isolated from the methanol extract of *A. Aspera* [2, 5]. Phenolic acids namely behenic acid and myristic acid were also identified [26]. The presence of phenylpropanoid namely asaron was identified in the plant *A. Aspera* [2, 7]. Polyphenol namely proanthocyanidin was identified from the roots and inflorescences extracts of *A. Aspera* using various solvent,s including petroleum ether, benzene, chloroform, ethyl acetate, ethanol and water [13]. The structures of phenolic compounds are given in Fig. 5.

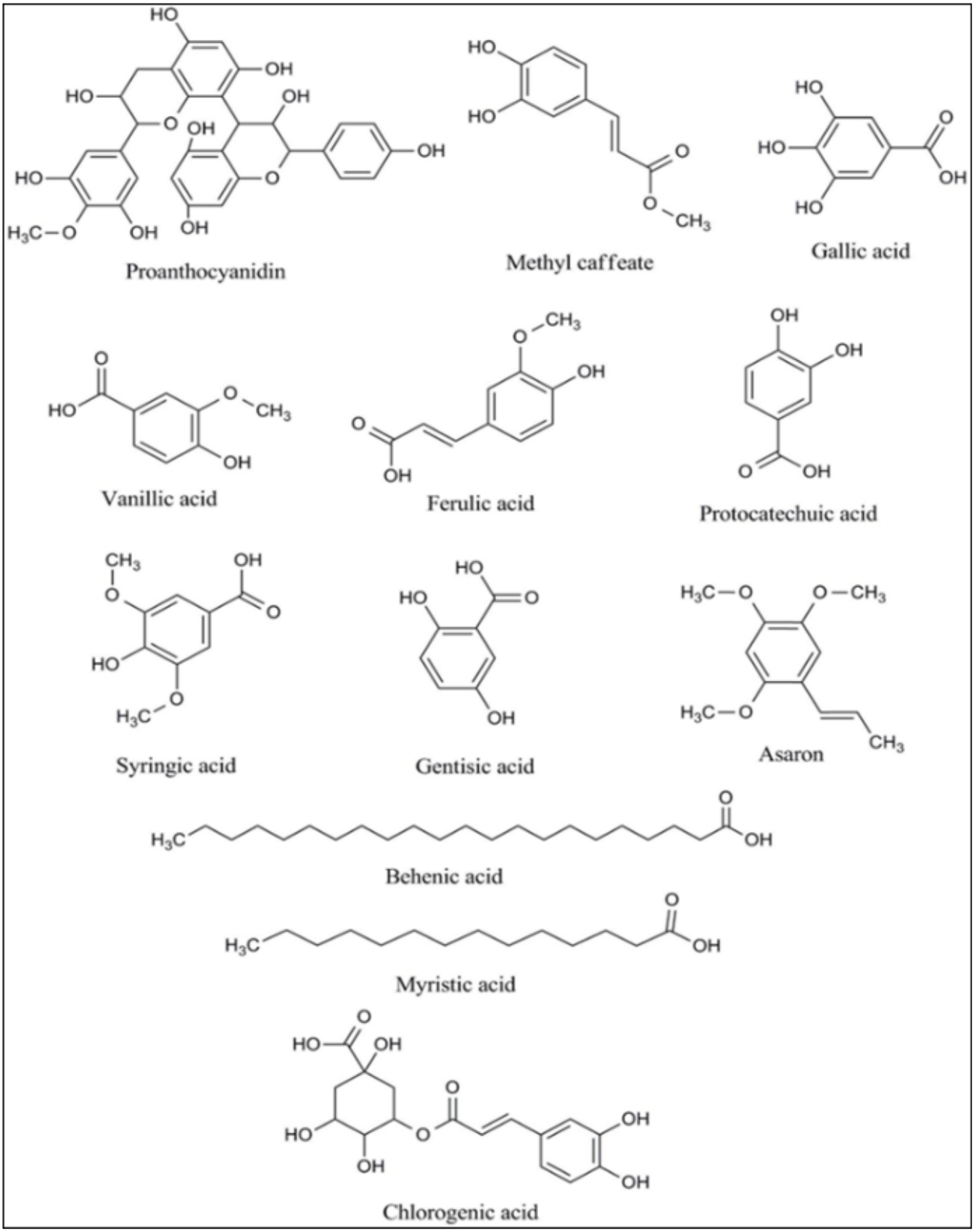

Fig 7: Structures of phenolic compounds from *A. Aspera*

6. Pharmacological activities

6.1 Hepatoprotective activity

Fahim, N. F., & Sathi, Z. S. (2018) found that the methanol extract of *A. Aspera* aerial parts protected albino rats from rifampicin-induced hepatotoxicity. Methanol extract decreased SGPT, SGOT, ALKP, and total bilirubin dose-dependently [15].

6.2 Antiviral activity

Verma, K. K., *et al*., (2021) study on inhibited the Epstein-Barr virus early antigen produced by 12-O-tetradecanoylphorbol-13-acetate. The fraction with mostly non-polar chemicals inhibited most (969.9% and 60% viability). Total methanol extract showed anticarcinogenic solid activity in the two-stage mouse skin carcinogenesis test. Anti-tumour promoters in carcinogenesis include the whole extract and fraction.

6.3 Anti-inflammatory action

The carrageenin-induced paw oedema and formalin models showed anti-inflammatory efficacy in rats from *A. Aspera* leaf and seed alcohol extracts. *A. Aspera* ethanol extracts at 50, 100, and 200 mg/kg were tested for acute and chronic inflammation in mice and rats with carrageenin and Freund's complete adjuvant paradigm [17].

6.4 Anti-arthritic action

Water-soluble alkaloid achyranthine for anti-inflammatory and antiarthritic efficacy against carrageenin-induced foot oedema, granuloma pouch, formalin-induced arthritis, and adjuvant arthritis in rats [18].

6.5 Spermidal activity

A. Aspera root ethanol extract inhibited female albino 37 post-coital fecundity. *A. Aspera* root extracts kill human and rat sperm. Pakrashi and Bhattacharya (1977) found that the whole plant benzene extract of *A. Aspera* aborted mice. The leaves methanolic extract also inhibited sperm [4].

6.6 Anti-fertility action

In mice, benzene crude extract aborted. In an isolated rat uterus, the alcoholic extract of *A. Aspera* root bark reduced the response to oxytocin but not serotonin or acetylcholine [4].

6.6 Antioxidant action

In vitro tests utilising 1, 1-diphenyl-2-picrylhydrazyl (DPPH) and the Hydroxyl Radical Scavenging Method assessed the antioxidant activity of *A. Aspera* crude root extract [4].

6.7 Hypoglycemic and anti-diabetic action

A. Aspera powdered whole plant aqueous and methanol extracts were hypoglycemic. Oral dosing of normal and alloxan-induced diabetic rabbits measured blood glucose (4). Streptozotocin-induced diabetic rats showed considerable hypoglycemic activity from *A. Aspera* seed ethanol extract [4]. *A. Aspera* powdered whole plant aqueous and methanol extracts. Oral dosing of normal and alloxan-induced diabetic rabbits measured blood glucose levels [1].

6.8 Larvicidal action

A. Aspera ethanol crude extract killed tick larvae against *Boophilus microplus*. *Aedes aegypti* and *Culex quinquefasciatus* were tested with *A. Aspera* leaf extract larvicidal saponins. Ethyl acetate leaf extract killed Aedes subpictus mosquito larvae. *A. Aspera* controls mosquito larvae. Steam-distilled leaf and stem essential oils killed *Aedes aegypti*, and *Culex quinquefasciatus*. *A. Aspera* leaf extracts kill *Aedes aegypti* [19].

6.9 Neuro-pharmacological action

A. Aspera methanol extracts were neuro-pharmacological. It is anxiolytic and antidepressant 50. Anti-hypertensive effects were tested *in vitro* [20].

6.10 Renal diseases

A. Aspera prevented calcium oxalate, calcium carbonate, and calcium phosphate urinary stone calcification. Methanol extracts prevented albino rat lead-induced nephrotoxicity. The plant roots were examined on calcium oxalate crystal nucleation and development *in vitro* and on NRK-52E (rat renal tubular epithelial) cell damage [4, 21].

6.11 Obesity prevention

Athesh K *et al*. 2021 found that the plant reduced obesity in clinical trials. *Aspera* prevents diarrhea in piglets and diures goats. Herbal formulations including the plant were tested to induce hepatopathy in sheep

6.12 Parathyroid activity

Sitinjak *et al* (2022) found prothyroidic and antiperoxidative activities in *A. Aspera* leaf extracts. The plant extract lowered hepatic lipid peroxidation and thyroid hormone levels in rats [23].

6.13 Immune modulation

Aspera immunostimulant Catla. *A. Aspera* consistently increased BSA-specific antibody titers ($p< 0.05$) compared to the untreated control group. *Labeo rohita* and *Rohu* fingerlings were fed *A. Aspera* seed to test its immunomodulatory effects. Superoxide anion generation, lysozyme, serum protein, bactericidal activity *A. Aspera* increased albumin-globulin ratios. In *Labeo, A. Aspera* boosts immunity and infection resistance. The control group had higher cumulative mortalities. Rohita [4, 24].

6.14 Antiallergic action

Datir *et al*. (2009) found that the petroleum ether extract (200 mg/kg, i.p.) of *A. Aspera* significantly reduced milk-induced leukocytosis and eosinophilia in mice. Thus, non-polar components of *A. Aspera* may be antiallergic [25].

6.15. Diuretic action

Raju *et al*. (2022) found that saponin from *A. Aspera* seeds had a considerable diuretic effect. *A. Aspera* plays an essential role in producing potent pharmacological actions. *A. Aspera* is widely used as a purgative, laxative, astringent, diuretic, and digestive [4].

6.16. Broncho-protective action

The ethanol extract of *Aspera* protected Wistar rats from toluene diisocyanate (TDI)-induced occupational asthma, according to Goyal *et al*. (2007) 64. Blood and BAL leucocytes were counted. Oxidative stress was measured using liver homogenate, while lung histology assessed airway inflammation [4].

6.17 Hypolipidemic activity: In triton-induced hyperlipidemic rats, 100 mg/kg *A. Aspera* alcohol extracts reduced blood cholesterol (TC), phospholipid (PL), triglyceride (TG), and total lipid (TL) by 60, 51, 33, and 53%, respectively. This medication reduced serum TC, PL, TG, and TL by 56, 62, 68, and 67% in normal rats after 30 days of chronic dosing at the same doses. Hepatic lipids also decreased significantly [4].

6.18 Heart rate

A. Aspera's water-soluble alkaloid achyranthine lowered blood pressure and heart rate, dilated blood vessels, and enhanced respiration in dogs and frogs, according to Neogi (1970). The 0.5 mg/ml alkaloid contracted frog rectus abdominal muscle less than acetylcholine (0.1 mg/ml) and did not prevent tubocurarine's spasmogenic activity [4].

6.19 Wound healing

The *Achyranthes aspera* were cleaned, and their wounds were allowed to heal. The excision and incision wound models were used in the research on wound healing activities [4, 29].

6.20 Antibacterial action

Plant leaf and callus extracts were antibacterial [14]. *A. Aspera* seed ethanol and chloroform extracts inhibited *Bacillus subtilis*, *E. coli*, and *Pseudomonas aeruginosa*. *Triterpenoid saponin* with alcohol inhibited *Staphylococcus* aureus dose-dependently. Ethanol extracts from the leaves and stem inhibited *Bacillus subtilis* and *Staphylococcus* (67). *B. subtilis* strains were inhibited by cattle dung heap seed [4].

6.21 Antifungal action

Londonkar, R. *et al*. (2011) reported that the methanolic extracts of the leaves of *Achyranthes aspera* exhibit substantial antibacterial action against the Gram-Positive (*S. aureus, Bacillus subtilis*), Gram-negative bacterial (*K. pneumoniae, E. coli*), and fungal species (*Aspergillus et al*.) [28].

6.22 Antiparasitic action

According to Singh, S. M. (2012), dried leaf, flower, and seed extract demonstrates antiparasitic effectiveness [3].

6.23 Anthelmintic action

For a preliminary evaluation of anthelmintic activity, 6, 8–10 cm *Pheretima Posthuma* worms were placed in a Petri dish with 30 ml of the stem's aqueous extract at 2.5, 5, 10, and 20 mg/ml in Tween 20 (1%) solution diluted with normal saline. Albendazole (2.5, 5, 10, and 20 mg/ml) was the reference standard and normal saline with Tween 20 (1%), the negative control [4].

6.24 Antipyretic action

Using a hot plate and brewer's yeast-induced aspirin techniques, the leaf methanol extract demonstrated antipyretic activity. Acetic acid-induced writhing and hot plate methods indicated analgesic efficacy in mice for leaves and seeds [4].

7. Conclusion

Achyranthes aspera (Latjeera) has many medical characteristics and medicinal compounds, including ecdysterone, amaranthine, betaine, pentatriaontane, 6-pentatriacontanone, hexatriacontane, and tritriacontane. The herb is spermicidal, anti-allergic, cardiovascular, nephroprotective, antiparasitic, hypoglycemic, analgesic, and antipyretic. Traditional uses include antiasthma, anticholera, purgatives, and laxatives for gastric diseases and urinary tract infections. There is still a need for research. Thus, *A. Aspera* is a prospective multipurpose medicinal plant that should be tested in clinical studies.

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