



**International Journal of Biology, Pharmacy
and Allied Sciences (IJBPAS)**
'A Bridge Between Laboratory and Reader'

www.ijbpas.com

AN UPDATED REVIEW OF *GREWIA HIRSUTA*- A MEDICAL MIRACLE FOR VARIOUS HEALTH ISSUES

DHIKALE RS^{1*}, BUTE D², BAWANKAR S², KUMBHAR P² AND GULECHA VS³

1: Associate Professor, HOD, Dept. of Pharmacognosy, SPES SNPT IOP, Nashik, Maharashtra,
India-422003

2: Final Year B.Pharm students, SPES SNPT IOP, Nashik, Maharashtra, India-422003

3: Principal, Dept. of Pharmacology, SPES SNPT IOP, Nashik, Maharashtra, India-422003

*Corresponding Author: Dr. Rupali S. Dhikale: E Mail: rupadhikale@gmail.com

Received 29th Jan. 2025; Revised 27th Feb. 2025; Accepted 9th April 2025; Available online 1st March 2026

<https://doi.org/10.31032/IJBPAS/2026/15.3.10016>

ABSTRACT

Grewia Hirsuta is a plant which belongs to the family of Tiliaceae. It is also known as Nagabala, Guda sharkara and Gangeruki. Veronicalolia is an English name of this plant. In Hindi, it is known as Kukurbicha. It is a shrub grown in high altitudes like Himalayan and Western Ghats. The forests in a geographical area ranging from India to Southeast Asia and China. *Grewia hirsuta* has high Medicinal value. The plant is found to have various chemical compounds like alkaloids, flavonoids, terpenoids, glycosides, steroids and phenols after Phytochemical. In folk and tribal medicine, it is used as nervine, brain tonic, antipyretic, diuretic, carminative, aphrodisiac, cardiac tonic. The aim of this review article is to reveal the hidden ayurvedic and medicinal information of *Grewia hirsuta*. This review is intended to provide a broad view on *Grewia Hirsuta*, beyond the currently available reviews and highlights future potential Pharmacological and chemical constituents research on side range of phytochemicals found in *G. Hirsuta*. Moreover, this review article will be helpful for the researchers in identifying the further scope for research on *Grewia Hirsuta* and to avoid the duplicity of work by not repeating the already done study.

Keywords: *Grewia Hirsuta*, Tiliaceae, Malvaceae, Phytoconstituent, Pharmacological uses

INTRODUCTION: -

According to the World Health Organization (WHO), “a medicinal plant is any plant which, in one or more of its organs, contains substances that can be used for therapeutic purposes, or which are precursors for chemo pharmaceutical semi synthesis” [1]. Medicinal plants are the backbone of the traditional medicine which means more than 3.3 billion people in the less developed countries utilize medicinal plants on a regular basis. The man was dependent on the traditional herbal medicines for the prevention and treatment of diseases, before the synthetic drug availability. The use of herbal medicines for curing diseases and prevention has been documented in the history of all civilizations. Plants with medicinal value have gained a lot of importance because of their potency and safety with which they can tackle not only the underlying disease but also bring other beneficial impacts on the whole body. These medicinal plants are considered as a rich resource of ingredients which can be used in drug development and synthesis. Besides that, these plants play a critical role in the development of human cultures around the whole world [2, 3].

Grewia Hirsuta from genus *Grewia* is an ethnomedicinally important plant having high medicinal value. The traditional uses are increasingly supported by recent scientific research wherein some species of

Grewia genus have now been confirmed to possess anticancer, anti-inflammatory, antioxidant, hepatoprotective, antidiabetic and antimicrobial properties [4]. There are about 159 species of *Grewia* that are grown in tropical and sub-tropical areas of Pakistan, India, China, Malaysia, South Africa, Australia, northern Thailand, and Nigeria [5]. Genus *Grewia* was named in the honor of Botanist Nehemiah Grew, who has the fame of being the father of plant anatomy [6]. *Grewia* belongs to a large flowering plant family Malvaceae according to Angiosperm Phylogeny group. Earlier *Grewia* was placed in either Tiliaceae or Sparrmanniaceae family since it matched the qualities of each genus. When these two genera studied and matched, they were not found to be monophyletic. (all descendants coming from same ancestors) in nature compared to Malvaceae. Therefore, these two genera were merged into one family, Malvaceae [7]. The *Grewia* species are also considered to be one of the most nutritious foods, since they are high in fiber, vitamins, carbohydrates, protein, and minerals, all of which are essential for a healthy lifestyle [8]. *Grewia Hirsuta* is a shrub or small tree, with branchlets are coarsely gray brown hairy. The plant has several common names, such as Gulasakari, Kukuranda, Kukurbica, Setarepari, Setapetu, Setajaraka, Govali, Jibilike, Tavidu, Gikkudippe, Huktapata,

Nagabala, Guda sharkara, and Gangeruki. In English, it is referred to as Veronicalolia. In Hindi, it is known as Kukurbicha. This particular plant species is commonly found in various regions of East Asia, including India, Sri Lanka, Thailand, Myanmar and Vietnam. In India specifically, it is primarily found in the Vindhya regions such as eastern Uttar Pradesh, Bihar and Rajasthan. It's typical habitat consists of mixed deciduous forests and dry evergreen forests [9]. *G. hirsuta* has been conventionally used to treat several disease conditions, such as rheumatism, joint pain, cholera, diarrhea and ulcers. The leaves of plants are useful in nose and eye diseases, anthelmintic [10]. The root is astringent to the bowel; useful in cholera, hydrophobia, kidney pain, piles,

anthelmintic [11]. Leaves and fruits are purgative, expectorants, carminative, abortifaciant, galactagogue; useful in splenic enlargement, eye troubles, piles, rheumatism pain in joints and in breasts [12].

This review is intended to provide a broad view on *Grewia Hirsuta*, beyond the currently available reviews and highlights future potential Pharmacological and chemical constituents research on side range of phytochemicals found in *G. Hirsuta*. Moreover, this review article will be helpful for the researchers in identifying the further scope for research on *Grewia Hirsuta* and to avoid the duplicity of work by not repeating the already done study.



Figure 1: Morphological Features of *Grewia Hirsuta*

Synonym: *Grewia longifolia* Buch.-Ham, *Grewia montana* Koen. ex-Wight & Arn., *Grewia pilosa* Roxb., *Grewia roxburghii* G. Don, *Grewia salvifolia* Wall., *Grewia*

saxatilis Buch.-Ham., *Grewia sulcoria* Buch.-Ham., *Grewia tomentosa* Roxb. ex Wight & Arn., *Grewia trichodes* Voigt [13].

Vernacular Name: [14]

Sanskrit	Gudasarkara, Nagabala, Gangeruki, Hraswa gawedhuka, Chatu: Phala, Jhasha
English	Veronicalolia
Hindi	Kakarundah, Kukurvicha, Jangalimethi. Gulaskari, Gangeran, Gulshakari
Kannada	Cikkudippe, Jana, Udipe, Dadachelu, Gandaudipe
Punjabi	Gangeran
Telugu	Jibilike
Urdu	Kakarundehrumi
Marathi	Govli.
Assamese	Hukta-pata , hakta-pata
Bengali	Kukurbicha
Khasi	Sohsynting
Oriya	Kakarolim
Nepali	Nagbala
Tamil	Kalunnu, Tavadu, Tavidu, Tavuttai.
Sinhalese	Sirivedibevela
Unani	Falsa
Arabian	Falsah, Kamafetusa
Persian	Palsh, Karafasrumi
Burma	Kyettayaw
Porebunder	Khaddharammi
Santal	Setaandir
Latin	<i>Grewia Hirsuta</i> Vahl.

Taxonomic classification: [15]**Kingdom:** Plantae**Phylum:** Charophyta**Class:** Equisetopsida (Magnoliopsida)**Subclass:** Magnoliidae**Order:** Malvales**Super order:** Rosanae**Family:** Malvaceae**Genus:** *Grewia***Species:** *Hirsuta*

Habitat: Common in the drier slopes in full sun. Hills 400-1000m, Peninsular India, Sri Lanka. Plain areas. Moist and dry deciduous forests, also in grasslands [16]. *Grewia Hirsuta* Vahl .is commonly found in countries like tropical Africa, Arabia, Madagascar, Himalaya, India, Srilanka, Vietnam, Pakistan, China, Bangladesh, Myanmar, Thailand, Malaysia, the pacific islands, and Northern Australia of the world.

It is occurring throughout the greater parts of India, ascending to 4,500 feet in the Himalaya, generally found in mixed deciduous open and dry evergreen forests [17].

Propagation: -

Seed of this genus is generally best sown as soon as it is ripe. Stored seed has a hard seedcoat and may benefit from scarification before sowing in order to speed up and improve germination. This can usually be done by pouring a small amount of nearly boiling water on the seeds (being careful not to cook them!), allowing the mix to cool somewhat and then leaving it in a warm place to soak for 12 - 24 hours. Sow the seeds in situ or in a nursery seedbed or trays - do not allow the compost to become dry. Germination and early growth are usually

quite quick. Cuttings - best taken with a heel [18].

Morphological description

Grewia Hirsuta is deciduous shrub or small tree that can be grown up to 5 meters tall. It is an Asian species of flowering plant. Its branches are slender with coarsely gray, brown colored hairy branches [5].

Leaves: The leaves are of lanceolate shaped and simple with 6-14 cm length and 2-3.5 cm width, with base rounded. Leaves are arranged alternate-distichous. The lateral basal veins of the leaves are upto half as long as the leaf blade, and the lateral veins occur in 4 to 5 pairs base narrow, shallowly heart-shaped, margin teeth blunt, tip long pointed or rarely blunt [5].

Flower: White flowers are born in cymes, 1-5 per leaf axil, 3-4 flowers. Stalk of the cyme is 3-7mm, velvety. Flower stalk is 3-5 mm and velvety. Sepals are narrowly lance shaped, 6.7*1.5mm. Stamens are 4-5mm. Style is longer than stamens, stigma is 4 lobed. Drupe is globose or 2-lobed, sparsely or coarsely hairy. Druplets 2 per lobe. Flowering from June-July [19].

Fruit: The fruits are small in size 7.5-10 mm diameter with hairy, more or less 2-4 lobed, 4 seeded, shining reddish purple, with scattered hair and a ring of hair at the top of the androgynophore. The fibrous roots are cylindrical in shape, with brown colored external surface [20].

Fruit	A globose, obscurely 4-lobed drupe; red when ripe, densely hirsute. Fruiting September onwards
Field tips	Leaves 3-nerved from base, stellate pubescent above, woolly below.
Leaf Arrangement	Alternate –distichous
Leaf Type	Simple
Leaf Shape	Oblong or lanceolate
Leaf Apex	Acuminate or acute
Leaf Base	Oblique, rounded or subcordate
Leaf Margin	Denticulate

Keystone Foundation: -Leaves 1-10×0.7-3.6cm, ovate, lanceolate, sub-cordate at base, apex acute, margin serrate, pubescent above, tomentose beneath. Flowers in axillary; peduncles 1-3 together. A spreading shrub about 9 ft with annual or periodic shoot. It is also found in grass lands. Flowers are yellow and fruit is drupe and reddish brown [14].

Chemical Constituents of *Grewia Hirsuta*:

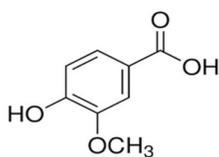
- The plant is found to contain diverse type

of phytochemicals including saponins, tannins, glycosides, alkaloids, anthraquinones, steroids. The plant is known to contain phenolics compounds like vanillic, syringic, Cis and trans ferulic, Cis and trans p-coumaric and gentisic acids, melilotic, p- hydroxy benzoic and protocatechuic acids [21]. The plant contains flavonol which is 4-methoxy kaempferol. The dried powder derived from the stem of *Grewia Hirsuta* comprises β -sittosterol, a-

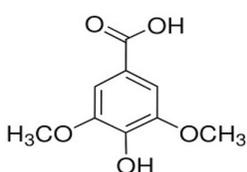
amyrin, β -amyrine, and foradol. The aqueous extract of this plant contains serine, proline, phenylalanine, isoleucine, glutamic acid and lysine. Phytochemical constituents such as aldehyde, alcoholic compound, α -curcumene, sesquiterpene, sesquiterpene alcohol, undecanoic acid, tetradecanoic acid, myristic acid, sesquiterpene oxide, n-hexadecanoic acid, palmitic acid, linoleic acid, oleic acid, gingerol and alkane are present. It contains ephedrine in large quantities. The mucilage of plant has mannose and xylose as sugar components [22].

Phytochemically the genus *Grewia* has been found to possess mainly triterpenoids, fatty component, flavonoids, steroids, saponins and tannin. The compound (4Z, 12Z)-cyclopentadeca-4, 12-dienone is isolated from *Grewia hirsuta*.

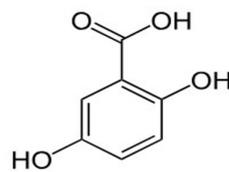
The phytochemical investigation of ethanolic leaf extract shows saponins, tannins, cardiac glycosides, alkaloids, anthraquinones, steroids, carbohydrates, reducing sugars, amino acids, phenolic compounds and flavonoids [23, 24].



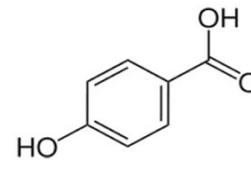
Vanillic acid



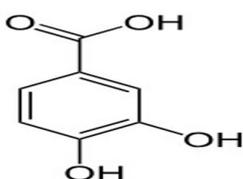
Syringic acid



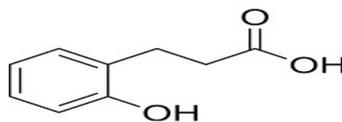
Gentisic acid



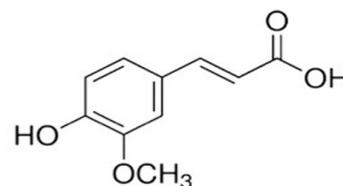
p-Hydroxy benzoic acid



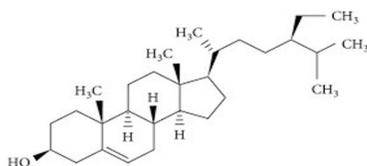
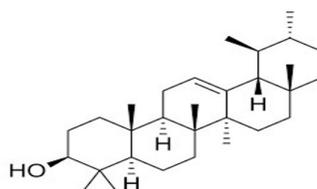
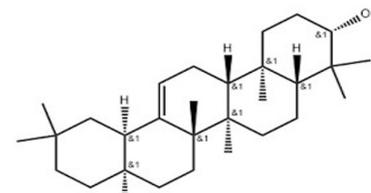
Protocatechuic acid

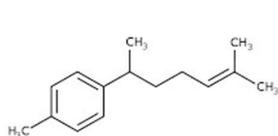
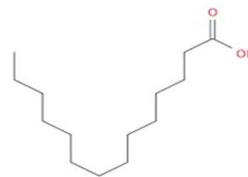
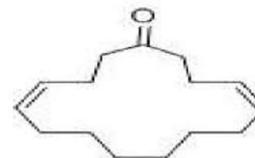
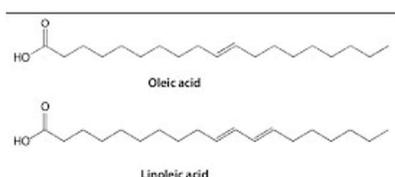
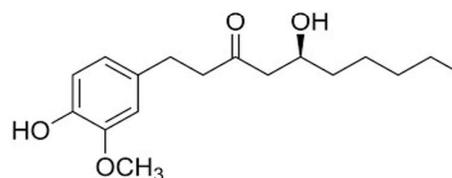


Melilotic acid



Ferulic acid

 β -sitosterol α -amyrin β -amyrin

**α-curcumene****Undecanoic acid****Tetradecanoic acid****Myristic acid****Palmitic acid****(4Z, 12Z)-cyclopentadeca-4, 12-dienone****Oleic and Linoleic acid****Gingerol****Ayurvedic Potential:**

Nagbala is an excellent Rasayana mentioned in Ayurveda useful in treatment of various diseases like tuberculosis, respiratory disorders. The powder of nagbala root and Arjuna (bark of tree Terminalia arjuna) is mixed and used with milk for the management of heart disease. The recipe is given to a patient about a month. It eradicates heat, cough and dyspnoea.

Powder with milk, ghee and honey or garlic is useful in weight gain. Dosage: Decoction: 50-100ml; Root bark powder: 3-6 gm [16]. As per Ayurvedic literature, this plant is considered to possess Vata-pitta shamak properties, meaning it has the ability to balance the air (Vayu) and fire (Pitta) elements in the body also parts of plants used are mainly roots, fruits, leaves and bark.

Rasa (Taste)	Madhura (sweet)
Guna (Qualities)	Guru (heaviness), Picchila (slimmy), Snighda (oily)
Vipaka	Madhura (Sweet taste after digestion)
Veerya	Sheeta (Coolant)
Effect on doshas	Balances Pitta and Vata dosha
Prabhava – Rasayana	Anti-aging (causes cell and tissue rejuvenation)

Uses: - *Grewia Hirsuta* Vahl is traditionally used in India to expel worms from the intestines. It is used for making ropes [25]. The ripe fruit is eaten; also the fruit is used to treat dysentery and diarrhea. The fruit is used for making sherbets [26].

Pharmacological Activities:

Antidiabetic Activity

The leaves were extracted, chemical components were separated by various chromatographic techniques (TLC and Column chromatography) and the fractions were tested for the hypoglycemic effect by in vitro α -amylase inhibitory assay [27].

Docking studies of the (4Z, 12Z)-Cyclopentadeca-4, 12-dienone with seven different target proteins showed that this is a promising candidate which docks well with various targets related to diabetes mellitus. ADME properties can be taken as best hit molecule and can be considered for further studies like QSAR. Thus (4Z, 12Z) - Cyclopentadeca-4, 12-dienone can be considered for developing into a potent antidiabetic drug [28].

Antioxidant Activity:

Antioxidant-based drug formulations are used for the prevention and adjunct treatment of complex diseases such as Alzheimer's, stroke, cancer, diabetes, and atherosclerosis, whose etiology is partly dependent on persistent oxidative damage by free radicals. In the present investigation

antioxidant activity *G. hirsuta* (Leaf and fruit) was studied with DPPH assay. Ethyl acetate, acetone, ethanol, chloroform and water extracts were used to analyze antioxidant property and ascorbic acid was used as standard. The study revealed that *G. hirsuta* (Leaf and fruit) possesses sound antioxidant activity. The acetone extract of the fruit showed highest antioxidant activities (70.69 ± 1.93) followed by ethyl acetate, ethanol, chloroform and aqueous extracts [29, 30].

Anticancer Properties:

Besides the tremendous development in anticancer therapies and drugs, the prevention of tumor generation by adopting a healthy lifestyle is generally considered as an effective strategy to reduce cancer risk. It is well established that diets rich in fruit and vegetables are useful in cancer prevention by virtue of their content of a wide variety of phytochemicals. Their preventive activity goes beyond the antioxidant capacity, and includes effects on the expression of oncogenes, tumor suppressor genes and transcription factors, and on cell cycle and apoptosis [31, 32].

Antimicrobial Properties:

Nine studies were reported in the mentioned category from 2011 to 2020, wherein two studies performed both antibacterial and antifungal activities, five studies reported only antibacterial activities, and lastly, two studies only evaluated the antifungal

potential. Out of nine total reported articles, *G. asiatica* was the most commonly explored i.e., *G. asiatica* was the focus in six studies and *G. optiva*, *G. lasiocarpa*, and *G. hirsuta* were the focus in 1, 1, and 1 study, separately. Five studies focused on leaves, two studies focused on fruit, and two studies used stem bark to evaluate the antibacterial and antifungal properties of the *Grewia* species. Researchers have shown that crude extracts of the *Grewia* spp. have valuable antibacterial activities predominately associated with their high flavonoid content [33, 34].

Hepatoprotective nature: -

Ethylene glycol, a xenobiotic is used to induce hepatotoxicity in mice. After inducing, the animals were fed with 200 mg/kg and 300 mg/kg of *G. hirsuta* leaves syrup extracted with ethanol. Animals treated with ethylene glycol resulted in elevated levels of liver enzymes like Serum glutamic pyruvic transaminase (SGPT) and serum glutamic-oxaloacetic transaminase (SGOT) etc. Consumption of ethanolic extract of *G. hirsuta* resulted in lowering the elevated levels of liver enzymes and also increased the level of proteins which aids in protecting the cells. This proves the beneficial factor of *G. hirsuta* extract and its hepatoprotective nature [35].

Anti-Inflammatory:

Evaluation of the anti-inflammatory activity of the Hydroalcoholic Extract of leaves of *Grewia Hirsuta* was performed using the formalin-induced rat paw oedema model using diclofenac sodium as the reference drug. Mean changes in paw oedema thickness of animals treated with the tested compounds from induction of inflammation was measured, together with the inhibition percent of oedema by the tested extracts at 2 dose level 100mg/kg and 200mg/kg. Results shown that all of the tested extract 200mg/kg was found more active. The results of the study suggest that *Grewia Hirsuta* possesses significant anti-inflammatory potential [36].

Immunomodulatory activity of hydroethanolic extract of Grewia-2024:

In vitro, immunomodulator models on human lymphocytes and In vivo carbon clearance model in Swiss albino mice were studied by lymphotoxicity and lymphocyte proliferation. Hydro ethanolic extract of *Grewia Hirsuta* has shown similar results of immunomodulation comparable with levamisole in statistically significant studies assessed by Dunnett's test. Hence it can be concluded that the Hydro ethanolic extract has shown decreased lymphocyte toxicity and increased lymphocyte proliferation [37].

Analgesic, Anti-Inflammatory, Anti-diarrhea and Anti-microbial Activities

The pain-relieving action of leaf extract was assessed by acetic acid, hot plate and formalin induced writhing method. In acetic

acid-induced analgesia, percentage of writhing inhibition for 250 and 500 mg/kg bw doses of plant extract and standard drug (Diclofenac sodium, 10 mg/kg bw) were 55%, 70% and 84% respectively. In formalin induced pain, extract of two doses and standard drug showed 66.01%, 76.3% and 82.608% writhing inhibition individually [29].

Memory enhancing activity:

Alzheimer's disease (AD) is a neurological disease that causes cognitive impairment. The current study focuses on investigating the memory-enhancing action of ethanolic root extract of *Grewia hirsuta* (ERGH) in a scopolamine-induced amnesia rat paradigm. Because of its facilitative effect on the retention of spatial memory in scopolamine-induced amnesia. ERGH treated rats showed considerable anti-oxidant activity, with increased levels of SOD, CAT, and GSH, as well as lower levels of MDA. The cholinergic neural networks play a key role in cognitive deficits associated with Alzheimer's disease, ageing, and neurodegenerative disorders. Piracetam and ERGH dramatically lowered AchE activity, indicating that both medications stimulate the cholinergic system result, the ERGH's memory-enhancing impact could be related to its anti-ChE activity [38].

Adaptogenic potential:

Hydroethanolic extract of *Grewia Hirsuta* (HEEGH) was tested at 250 and 500 mg/kg.

The behavioral and biochemical studies comprise of glucose, cholesterol, triglycerides, total protein, SGPT, SGOT, BUN, and cortisol were estimated. Adrenocorticotrophic hormone causes tropisms of adrenal glands and spleen at the expense of liver functions as a result of the stress induced response. The extract at two different level doses reduces the secretion of corticosterone from adrenal cortex and other biochemicals. The extract of *Grewia Hirsuta* is having abundant polyphenols, flavonoids and tannins which are established antioxidants. The plant extract is having a good adaptogenic activity due to phytochemicals of antioxidant activity [39, 40].

Non-toxic Potential:

The total phenolic content, flavonoid content and tannin content were estimated with the help of UV, FTIR and HPLC studies. The oral acute toxicity was performed as per OECD guidelines 425. The plant is a rich source of antioxidant molecules. The extract was found to be safe and non-toxic to vital organs, and does not interfere with hematological and biochemical reactions in vivo. The extract did not show any acute toxicity and mortality at the dose of 2 g/kg when observed for two weeks. This study establishes the Non-toxic nature of hydroethanolic extract of *Grewia Hirsuta* at administrated dose of 2 g/kg [41-44].

Acknowledgements: The author is grateful to the management of SPES SNPT IOP for providing all possible help.

REFERENCES: -

- [1] Singh R. Medicinal Plants: A Review. *J. Plant Sci.* 2015, 3(1-1), 50-55. doi: 10.11648/j.jps.s.2015030101.18.
- [2] Goyal PK. Phytochemical and Pharmacological properties of the Genus *Grewia*: A Review. *Int J Pharm Pharm Sci.* 2012;4(4):72-78.
- [3] Rasool Hassan BA. Medicinal Plants (Importance and Uses). *Pharmaceutical Anal Acta.* 2012;3(10):1.
- [4] Singh N., Irchhaiya R., Dudhe R., Kumar S. Phytochemical screening and immunomodulator activity of *Grewia asiatica* Linn. leaves. *J. Adv. Sci. Res.* 2019; 10:166–171.
- [5] Ullaha W, Uddina G, Siddiqui BS. Ethnic uses, pharmacological and phytochemical profile of genus *Grewia*. *J Asian Nat Prod Res.* 2012, 14:186-195.
- [6] Abujam RD. Nutritional and medicinal properties of phalsa (*Grewia asiatica*) and its therapeutic application- a review. *Univ. Res. Reso J.* 2018;1(2):226-233.
- [7] Chung R. Revision of *Grewia* (*Malvaceae-Grewioideae*) in peninsular Malaysia and Borneo. *Edinb. J Bot.* 2005;62(1-2):1-27.
- [8] Sutharsingh R., Kavimani S., Jayakar B., Uvarani M. and Thangathirupathi A. Quantitative phytochemical estimation and antioxidant studies on aerial parts of *Naravelia zeylanica* DC. *Int. J. Pharm. Studies Res.*, 2011; 2: 52-56.
- [9] Sharma N., Patni V. Comparative analysis of total flavonoids, quercetin content and antioxidant activity of in vivo and in vitro plant parts of *Grewia asiatica* Mast. *Int. J. Pharm. Pharm. Res.* 2013; 5:464–469.
- [10] Hutke VD, Naswale M. Screening of various extracts of *Grewia hirsuta* leaves and fruits for secondary metabolites. *J Med Plant Res.* 2017; 5(1): 323-325.
- [11] Rajan MD., Sarumathy K., Palani S., Sakthivel K., Vijay T. Phytochemical studies by GC-MS and cardioprotective effect of *Grewia hirsuta* on doxorubicin induced cardiotoxicity in albino rats. *Int. J. Univers. Pharm. Bio Sci.* 2011; 1:1–18.
- [12] <https://allayurvedic.in/blogs/news/nagbala-or-grewia-hirsuta-benefits-medicinal-properties-uses-and-side-effects>.

- [13] Dhavan BN, Patnaik GK, Singh KK, Tandon JS. Screening of Indian plants for biological activity: Part IV. Indian J Exp Biol. 1977; 15:208-219.
- [14] Bhakuni DS, Dhar ML, Dhar MM, Dhawan BN, Gupta B, Shrimal RC. Screening of Indian plants for biological activity: Part-III. Indian J Exp Biol. 1971; 9:91-102.
- [15] Kirtikar KR, Basu BD. Indian medicinal plants, International book distributors, Dehradun, India, 1995, 1.
- [16] Dr. Chandra Barooah & Iftikher Ahmed (2014) Assam Science Technology and Environment Council.
- [17] Indian Institute of Science (IIS). Bangalore: Digital flora of Karnataka by herbarium JCB.
- [18] Birudu RB, Padmavathi P. Secondary metabolites of ethanolic leaf extract of *Grewia hirsuta*. European Journal of Biomedical and Pharmaceutical Sciences. 2018; 5(1):868-870.
- [19] Vinuth Chikkamath, Venkatrao H Kulkarni, Prasanna V Habbu, Preeti V Kulkarni. *Grewia hirsuta* Vahl Chemical Constituents and Biological Activities. RGUHS Journal of pharmaceutical Science. 2019; 9(3): 3-10.
- [20] Indian institute of science (IIS) [internet]. Bangalore: Digital flora of Karnataka by herbarium JCB [cited 2019 Nov 24] available from: <http://florakarnataka.ces.iisc.ac.in/hjcb2/herbsheet.php?id=4216> and [cat=1](#)
- [21] Thai Forest Bulletin (Botany) No. 16 Publisher-The Forest Herbarium; Bangkok. Year-1986, ISBN -0495-3843.
- [22] www.flowersofindia.net/catalog/slides/Nagbala%20crossberry.html
- [23] Sengupta A and N. Kawthankar. 2024. *Grewia hirsuta* Vahl-Nagbala. In kunte, K.S. Sondhi and P. Roy. Butterflies of India, v.4.12. Published by the Indian foundation for butterflies. <https://www.ifoundbutterflies.org/grewia-hirsuta>.
- [24] Natarajan A, Sugumar S, Bitragunta S, Balasubramanyan N. Molecular docking studies of (4Z, 12Z)-cyclopentadeca-4, 12-dienone from *Grewia hirsuta* with some targets related to type 2 diabetes. BMC Complement Altern Med. 2015; 73:1-8.
- [25] Mesaik MA, Ahmed A, Khalid AS, Jan S, Siddiqui AA, Perveen S. Effect of *Grewia asiatica* fruit on glycemic index and phagocytosis

- tested in healthy human subjects. Pak J Pharm Sci. 2013; 26(1):85-89.
- [26] Abirami N, Natarajan B. Isolation and characterization of (4Z, 12Z)-cyclopentadeca-4, 12- dienone from Indian medicinal plant *Grewia hirsuta* and its hyperglycemic effect on 3T3 and L6 cell lines. IJPPR. 2014; 6(2): 393-398.
- [27] Birudu RB, Padmavathi P. Secondary metabolites of ethanolic leaf extract of *Grewia hirsuta*. European Journal of Biomedical and Pharmaceutical Sciences, 2018; 5(1):868-870.
- [28] Goyal P.K Int J Pharm Pharm Sci. Vol 4, Suppl 4, 72-78; 2012 ISBN-0975-1491.
- [29] Segovia-Siapco G, Sabaté J. Health and sustainability outcomes of vegetarian dietary patterns: A revisit of the EPIC-Oxford and the Adventist Health Study-2 cohorts. Eur. J. Clin. Nutr. 2018; 72:60–70. doi: 10.1038/s41430-018-0310-z.
- [30] Abirami N, Natarajan B. Isolation and characterization of (4Z, 12Z)-cyclopentadeca-4, 12- dienone from Indian medicinal plant *Grewia hirsuta* and its hyperglycemic effect on 3T3 and L6 cell lines. ijppr. 2014; 6(2); 393-398.
- [31] Abirami Natarajan, Shobana Sugumar, Sivakumar Bitragunta and Natarajan Balasubramanyan. Molecular docking studies of (4Z, 12Z)- cyclopentadeca-4, 12-dienone from *Grewia hirsuta* with some targets related to type 2 diabetes. Complementary and Alternative Medicine. 2015; 15:73.
- [32] Choudhary IM, Siddiqui J, Abbaskhan A, Naheed S, Adhikari A, Awalia JJ.A. Bio-Active Antioxidants from Plant Foods for Nutraceutical Product Development. U.S. Patent 13/759. 2018 June 26.
- [33] Varsha D Hutke and Mayuri P Naswale. Evaluation of in vitro antioxidant activity of different solvent extracts from *Grewia Hirsuta* (Vahl). Int. J. Adv. Res. Biol. Sci. 2020; 7(10): 110-115.
- [34] Catanzaro E, Calcabrini C, Turrini E, Sestili P, Fimognari C. Nrf: A potential therapeutic target for naturally occurring anticancer drugs. Expert Opin. Ther. Targets. 2017; 21:781–793. doi: 10.1080/14728222.2017.1351549.
- [35] Ismail T, Calcabrini C, Diaz A, Fimognari C, Turrini E, Catanzaro E, Sestili P. Ellagitannins in cancer

- chemoprevention and therapy. *Toxins*. 2016; 8:151. doi: 10.3390/toxins8050151.
- [36] Iftikhar M, Zahoor M, Naz S, Nazir N, Batiha G E.S, Ullah R, Bari A, Hanif M, Mahmood HM. Green synthesis of silver nanoparticles using *Grewia optiva* leaf aqueous extract and isolated compounds as reducing agent and their biological activities. *J. Nanomater.* 2020; 2020:8949674. doi: 10.1155/2020/8949674.
- [37] Dattatraya Kature, Gaurav Gupta, Ritu Gilotra. Phytochemical Investigation & Antibacterial Activity of Hydroethanolic Leaf Extract of *Grewia Hirsuta* Collected from Forest. *SGVU Journal of Pharmaceutical Research & Education*, 2020, 5(1): 423-431.
- [38] Basha SR, Siddapa RD, Jilani D, Kumar GK, Veena V. Preclinical evaluation of hepatoprotective activity of *Grewia Hirsuta* extract on ethylene glycol induced liver damage in Wister albino rats. *IJRPA*. 2015; 3(6) :2320-3471.
- [39] Mr. Mahendra Jaiswal, C.K.Tyagi, Dr. Prabhakar Budholiya. Evaluation of Bioactive Constituents and In-Vivo Anti-Inflammatory Activity of Hydroalcoholic Leaves Extract of *Grewia Hirsuta*. *Journal of Biomedical and Pharmaceutical Research*. 2021; 10(2):9-14.
- [40] Chikkamath V, Kulkarni V, Habbu P, Nagappa AN. In vitro and In vivo Immunomodulatory Activity of Hydro Ethanolic Extract of *Grewia Hirsuta* Vahl. *Int. J. Pharm. Investigation*. 2024;14(2):539-46.
- [41] N.Yamini, B.Pushpa kumari, S.Mehathaj, V.Phani deepthi. Effect of *grewia hirsuta* vahl ethanolic root extract on cognition in scopolamine induced amnesia. *UPI J. pharm. med. health sci.* 2021; 4(4): 36-43.
- [42] Vinuth Chikkamath, Venkatrao. H. Kulkarni, Prasanna. V. Habbu, Anantha Naik Nagappa. Evaluation of Adaptogenic Potentials of Hydroethanolic Extract of *Grewia Hirsuta* Vahl. In *Experimental Animals. Journal of Population Therapeutics & Clinical Pharmacology*. 2023; 30 (4): 667-676.
- [43] P. Dharani Prasad, Paromita Chowdhury, Deepak Katiyar, Bindiya Chauhan, Vakkalagadda Ravi Kumar, Om M. Bagade, Mohammad Salman, Ganesh More. Evaluation of Hydroethanolic Extract of *Grewia Hirsuta* Vahl for

In Vivo Adaptogenic Potentials.
2023; 8(4):961-971.

- [44] Vinuth Chikkamath, Venkatrao. H. Kulkarni, Prasanna. V. Habbu, Anantha Naik Nagappa. *Grewia hirsuta* Vahl. Hydroethanolic Leaf Extract: Phytochemical and Acute Toxicological Studies. RGUHS Journal of Pharmaceutical Sciences. 2022;12(1):23-30.