ISSN:2319-2607 IISUniv.J.Sc.Tech.Vol. 7&8(1), 17-24 (2018 & 19)
REVIEW ARTICLE

A Comprehensive Review on Genus *Grewia*

Poonam Sharma, Kalpana Agarwal*
Department of Botany, IIS (deemed to be University, Jaipur)

Abstract

All over the world genus *Grewia* is well-known for its medicinal properties. Phytochemicals such as anthocyanins, alkaloids, lactones, triterpenoids, glycosides, flavones, phenolics, lignans, organic acids and steroids are isolated from different species of *Grewia*. These compounds are used in traditional medicinal systems like Ayurveda and Unani, as well as in the modern medicinal system. It has various medicinal properties and used in the treatment of several diseases like cardiovascular disease, diabetes, skin diseases, fever, obesity, pains. The extracts of various parts of the plants of this genus, like stem, bark, root and leaves are used in antibacterial, anti-pyretic, anti-oxidant, anti-malarial, anti-inflammatory, anti-emetic, analgesic, and hepatoprotective activities. It is not only known for various phytochemical properties, but also for many other purposes. Fruit of *Grewia asiatica* is nutritionally rich, gum of *Grewia mollis* shows good resistance to viscosity after heating, seeds of *G. bicolor* contain fatty acid and exhibit physicochemical properties and so is a good supplement in making paint, cosmetic and soap industries. The review primarily focusses on compiling and documenting data pertaining to the use of genus *Grewia* like medicinal properties, use in paint and cosmetic industries, breeding behavior, phytochemical investigations, geographical distribution and some more.

Keywords: Drought, Environment, Medicinal, Pharmacology, Traditional

Introduction

In ancient time it was believed that natural plant products and methods were beneficial for good health and for curing diseases and pain. This system is revived again and vital efforts are introduced to conserve and promote traditional medicinal knowledge about plant drug. The review article focusses on phytochemical and medicinal properties of genus *Grewia*. Around 40 species of genus *Grewia* are found in India. *G. tenax*, *G. hirsuta*, *G. damine*, *G. lasiodiscus*, *G. optiva*, *G. biloba*, *G. bicolor*, *G. tiliaefolia*, *G. flavescens* are the most commom species. It is not only used as a folk medicine but also as a source of livelihood for poor families but there is a prodigious need for further investigations in near future. (Sharma and Patni, 2012; Paul, 2015).

Grewia tenax (Frosk.) Fiori is the member of family Tiliaceae. The plant is used as food, fodder, fiber, fuel wood, timber. This species is also used in traditional medicine systems because of its various phytochemical properties. The limitations to grow this species are the prolonged seed dormancy and less characterized vegetative propagation. Researchers display that Phalsa (*Grewia asiatica* L.) is a native of India and Southeast Asia and member of Tiliaceae family. Fruiting takes place in hot and dry weather which ripens in the month of June. During winter season the plant is in a dormant stage and shed off its leaves. *Grewia asiatica* is commonly called as phalsa and is a shrub. It has been cultivated as a small fruit crop and is considered as a folk medicine among various tribes in Rajasthan. It is known by many common names like white crossberry, phalsa cherry, raisin bush, gangara, gangu, kanger, gondni and gangeran. Fresh ripe phalsa fruits are used in soft drinks or used as a refreshing fruit during summer, especially in the month of May and June in India (Salunkhe and Desai 1984). Fruiting time and life period of *Grewia* is very short limiting to local markets for short distribution (Anand, 1960). *G. macrophylla* is found in elevated hilly forests in the northeast region of India and Myanmar, whereas, *G. abutilifolia* is spread all over India and Southeast Asia. (Nandikar and Ravikumar, 2017).

Taxonomic classification

Kingdom Plantae
Division Angiospermae
Class Dicotyledonae
Sub Class - Polypetalae
Order Malvales
Family Tiliaceae
Sub-family Grewioideae
Genus *Grewia*
Species *abutilifolia*, *asiatica*, *bicolor*, *coriacea*, *optiva*, *tenax*, *tiliaefolia* and *villosa*

*Corresponding Author Email : kalpanaicg@gmail.com

Ethnobotany

Grewia species are consumed as appetizer, antithirst, tonic, sweet astringent, cooling agent and aphrodisiac. According to the Ayurveda the fruit is used as a digestive juice and gives cooling effect on body. Unripe fruits are used to cure vatta doshas, cures burning of vagina and urinary troubles. According to Unani medicine system, bark and root are helpful to cure cardiovascular diseases, fever, diarrhea, blood disorder, rheumatism and diabetes. Fruit extract of *G. asiatica* is utilized in antihyperglycemic activity by enhancing anti-inflammatory and antioxidant effects of *â* cells in pancreas (Khattab *et al*., 2015). Seed extract, seed oil and bark are used as antifertility agent. Phalsa fruit contains ascorbic acid and is very rich in vitamin C. Leaves are used in skin treatments. The ash of the leaves is mixed with butter to make poultice. The poultice is applied on wounds and abscesses specially in children. The leaves are also used as fodder for cattle, especially for goats. The dried plant is used as fuel wood species. The Poultice is a mixture of butter and ash of leaves which is used for abscesses & wounds especially in kids. Cattle like goats graze leaves, therefore consumed as fodder and the dehydrated plant is used as firewood species (Marwat *et al*., 2011). The use of wood of *Grewia subinaequalis* has also been reported by Bennet S.S.R., 1985. In Indian sugar factories bark extract is used in cleaning process of sugarcane juice. Bark is not only used as a medicine but has other uses as well like making ropes and other small scale industries. (Tripathi *et al*., 2010).

According to the investigations by Connor and Ford 2014, *Grewia flava* and many other taxa like *Leptospermum scoparium*, *Boscia senegalensis*, *Euclea undulata* or *Diospyros lycioides* are suggested for planting to reduce the desertification. These shrubs have multiple benefits, including having a faster growth rate and supporting the basis for occupations based on bee-keeping and honey production.

Almost all the species of Genus are known to have one importance or other. The fruit of *Grewia bicolor* is also edible and consumed for saucess. The bitterness of Sorghum beer is reduced by the bark of this plant and is in practice for some communities of Burkina Faso (Orwa *et al*., 2009). These ripe fruits are consumed afresh into soft drinks during summer. The only drawback of the fruit is that it has a short shelf life, therefore suitable exclusively for local marketing.

Table 1. Distribution of species of genus *Grewia*

S.No	Species	Common name	Area/ Distribution	Reference/s
1.	*G. abutifolia*	Assamese Korai-guti	Indo-Malaysia & India (Kerala, Assam, Meghalaya and Odisha)	Baruah & Ramakrishnan, 1989
2.	*G. optiva*	Dhaman&Bihul	Himalayan regions of India, Pakistan & Nepal	Dhyani *et. al*., 1990
3.	*G. asiatica*	Phalsa	Southern Asia, East Cambodia, Pakistan, India (Punjab, Rajasthan, Uttar-Pradesh, Delhi, Haryana and Andhra Pradesh)	Tripathi *et al*., 2010
4.	*G. tenax*	Gangeti	Saudi Arabia, Ethiopia, Iran, Kenya, Morocco, Oman, South Africa, Afghanistan, India (Rajasthan, Gujarat, Madhya Pradesh, Kerala, Tamil Nadu, Punjab, Himachal Pradesh, Jammu & Kashmir, Assam and West Bengal)	Dev *et al*., 2017
5.	*G. villosa*	Luska	Egypt, Pakistan, Tropical Africa, East Indies, Arabia, India (Kerala, Tamil Nadu, Andhra Pradesh, Maharashtra, Karnataka, Punjab, Rajasthan, Uttar Pradesh and Gujarat)	Dev *et al*., 2017
6.	*G.tiliaefolia*	Dhamani	Pakistan, Southeast Asia, USA, Burma India (Andhra Pradesh, Punjab, Uttar Pradesh, Chennai, Mumbai)	Badami *et al*., 2002
7.	*G. coriacea*	Cameroon	Republic of Congo and Central Africa	Sita *et al*., 1988; Bita *et al*., 2016
8.	*G.bicolor*	White raisin and false brandy bush	Eastern and Southern Africa; India and Saudi Arabia	Le Houerou, 1980; Brink, 2007

Geographical Distribution(Table 1)

Grewia species is a native plant of Southern Asia found from Pakistan to East Cambodia and widely cultivated in tropical regions. This genus is commonly found in arid and semi-arid areas of Indian sub-continent and Pakistan. West Bengal, Andhra Pradesh, Gujarat, Karnataka, Madhya Pradesh, Punjab, Maharashtra, Kerala, , Haryana, Rajasthan, Tamil Nadu and Bihar are the states in which *Grewia asiatica* is found (Tripathi, 2009). Outside India, it is widely spread over Iran, Algeria, Chad, Botswana, Djibouti, Kenya, Ethiopia, Mali, Mauritania, Namibia, Nigeria, Niger, Saudi Arabia, Senegal, South Africa, Somalia, Sudan, Uganda, Tanzania, Morocco, Zimbabwe (Dev *et al.* 2017).

Wani *et al.*, 2015 reported that *G. asiatica* is self- compatible and self-fertile. Copious ants are responsible for the various services in *G. asiatica*. The numerous breeding behavior of different members of the Malvaceae family, especially in *G. asiatica* proved that these plants effectively survive in sub-tropical and tropical conditions worldwide (Nayak and Davidar, 2010). It is reported that an appropriate level of nutrients are necessary for proper growth and development of Phalsa or *Grewia asiatica* plant. The augmented standards of nourishment application are of great importance to get a good yield. Gill *et al.*, 2015 formulated the best possible combination of the inorganic fertilizers which can stimulate production in these plants.

Table 2. Medicinal properties of different plant parts of *Grewia species*

S.No	Species	Plant Part	Medicinal property	Reference/S
1.	*G. coriacea*	Fruits	Alzheimer s disease, Diabetes, cancer and cardiovascular disorders	Tan *et al.*, 2014
2.	*G. asiatica*	Fruits	Antioxidant activity, Cooling and astringent, anticancer, radioprotective and antihyperglycemic properties	Bhakuni, 1971; Muhammad *et al.*, 2013; Siddiqi *et al.*, 2013
		Leaves	Antimicrobial, anticancer, antiplatelet and antiemetic activities	Muhammad *et al.*, 2013
3.	*G. bicolor*	Leaves, bark & roots	Anti-oxidant, hepatoprotective, anti-inflammatory, anti-emetic, anti-malarial, analgesic and anti-pyretic activities	Ullah *et al.*, 2012
4.	*G.villosa*	Stem and bark; wood	Dysentery; antidote for opium poisoning	Ullah *et al.*, 2012
5.	*G. tenax*	Whole plant	Antibiotic property, treatment of tonsillitis and trachoma; cosmetic industries; diarrhea, hemorrhoids, hypoglycemia, and fungal or microbial infections	Akhtar *et al.*, 2000; Hotez *et al.*, 2008; Sharma and Patni, 2012
6.	*G. abutilifolia*	Bark	Syphilis and intestinal diseases	Ngantsoue *et al.*, 2005
		Roots	Abscesses	Joshi *et al.*, 1980
7.	*G. optiva*	Fruits & bark	Anti-inflammatory, Astringent & diarrhea	Aratanechemuge, 2004
8.	*G. tiliaefolia*	Roots and bark	Diarrhea, skin diseases, ulcers and hypertension, apoptosis in cancerous cells	Raghunathaiyar, 1996; Aratanechemuge *et al.*, 2004

Medicinal Properties and Other Uses(Table 2)

Grewia has been reported to demonstrate enormous therapeutic activities being a rich source of various phytochemicals and antioxidant essential for day to day life. (Sinha *et al.*, 2015). Several compounds like triterpenoids, steroids, glycosides, flavones, lignans, phenolics, alkaloids, lactones and organic acids are obtained by phytochemical analysis from various speciesof this genus like *G. asiatica, G. bicolor, G. bilamellata, G. hirsute* that may provide protection against various chronic diseases.

Of the three genus, *Grewia asiatica, Eugenia jambolana* and *Carissa caranda,* studied by Siddiqi *et al.*, 2013, *G. asiatica* demonstrated the maximum antioxidant activity. Fruit of *G. asiatica* is used as a cooling and astringent agent. Rheumatism and pustular eruptions are treated by root bark and leaves respectively, whereas stem bark are used to control blood sugar level (Bhakuni *et al.*, 1971). Regardless of its incredible importance, the fruit is not much accepted for commercial cultivation as an important fruit plant because of its small size and delicate nature. (Chakraborty *et al.*, 2004).

Fruit is a good source of amino acids, proteins, minerals & vitamins and secondary metabolites like tannins, flavonoids, anthocyanins and phenolics are obtained from it (Pederson, 2009). The leaves possess anticancer, antiplatelet, antiemetic and antimicrobial activities; fruit has antihyperglycemic, antioxidant, anticancer and radioprotective properties while stem bark holds anti-inflammatory and analgesic activities. (Zia-Ul-Haq *et al.*, 2013). It was concluded by the biochemical and histopathological experimental studies of hepatoprotective efficacy in *Grewia asiatica* fruit against swiss albino mice that *G. asiatica* also has the potential against radiation (Sharma and Sisodia, 2010). It was examined that *Grewia subinaequalis* and *Grewia asiatica* (Phalsa) are used as food and herbal medicine. The fruit is used to cure stomach ache, respiratory, cardiac and blood disorder as well as in fever. Rheumatism can be treated by its roots and barks. Leaves are used for skin treatments. The plant holds antidiabetic, antioxidant, antihyperglycemic, radioprotective, hepatoprotective, antimicrobial, analgesic, antifertility, antifungal, antipyretic and antiviral activities (Sinha *et al.*, 2015). According to the findings *Grewia subinaequalis* (Phalsa) has been used since the Vedic period.

Liver abscesses are reported to be curable by roots of *G. abutilifolia* (Joshi *et al.*, 1980). Antifertility properties are present in its seed oil and extract (Ahaskar *et al.*, 2007). Morton, 1987 reported that fruit relieves in inflammation, respiratory and cardiac syndromes and reduces fever. Cough problems, intestine and bladder problems are cured by the roots of *Grewia sclerophylla*. Alcoholic extraction of aerial parts of this genus is used to treat cancer (Dhar *et al.*, 1974). *G. umbellata* leaves are used to heal wounds whereas *Grewia tiliaefolia* roots and bark are used to cure diarrhea, skin diseases, ulcers and hypertension (Raghunathaiyar, 1996). There is a vast use of *G.tiliaefolia*

Table 3. Phytochemical properties of different plant parts of *Grewia* species

S.No	Species	Plant Part	Chemical constituents	Reference
1.	*G. villosa*	Roots	Steroids, terpenoids, alkaloids, phenols, glycosides, tannins, carbohydrates	Rao & Kumar 2018
2.	*G. tiliaefolia*	Leaves	Alkaloids, flavonoids, tannins and saponins	Kumar & Venkatachalam, 2016
3.	*G. optiva*	Stem & bark	Alkaloids, terpenoids, tannins, saponins and flavonoid.	Anwar *et al.*, 2015
4.	*G. coriacea*	Whole plant	Polyphenols, flavonoids, tannins and anthocyanins	Madiele *et al.*, 2015
5.	*G. tenax*	Whole plant	Terpenoids	Ahmed *et al.*, 2011
6.	*G. bicolor*	Whole plant	Triterpenoids, Alkaloids and β-sitosterol	Jaspers *et al.*, 1986
7.	*G. abutilifolia*	Bark and Roots	Triterpenes and alkaloids	Jaspers *et al.*, 1986; Arora, 2011
8.	*G. asiatica*	Leaves	Flavonoids	Ali *et al.*, 1982
		Flowers	Flavonoids, β-sitosterol and 3,21,24-trimethyl-5,7-dihydroxyhentriacontanoic acid δ-lactone	Lakshmi *et al.*, 1976; Lakshmi and Chauhan 1976
		Fruits	Proteins, flavonoids and amino acids	Lakshmi *et al.*, 1976
		Stem	Triterpenoids and β-sitosterol	Chattopadhyay and Pakrashi, 1975

in the treatments of throats, nose, blood, burning sensation, dysentery, cow-itch, vata, kapha, healing of wounds and biliousness and also used as an antidote for opium poisoning (Thakur and Sood, 2005). Aratanechemuge *et al*., 2004 investigated that a lupenol compound is found in *G. tiliaefolia* which cause apoptosis in cancerous cells. Bark and roots of *Grewia villosa* are used in the treatment of urinary complaints and diarrhea respectively. It was stated that other parts of this species are useful in diseases like cholera, sores and for the healing of wounds (Jain and Tarafder, 1970; Kirtikar and Basu, 1975).

Phytochemical Properties (Table 3)

Plants can be estimated as a main concern in the list of national priorities in developing countries. In developing countries flora remains unexploited and present as a rich source of raw material in preparation of making drugs.Various types of drugs are obtained from plants which are used to cure numerous type of diseases (Farnsworth *et al*., 1985).

Grewia asiatica or phalsa is a nutritional and a therapeutic plant and can be grown in shortage supply of water. Moderate amounts of steroids, saponins and alkaloids & small amount of tannins are extracted from fruits of *G. asiatica*, but on the other hand flavonoids, phenolic acids and glycosides are found in big quantity in phytochemical analysis. It lacks triterpenoids and resins (Lakshmi *et al*., 1976: Khattab *et al*., 2015). Researchers have examined the antioxidant and cytotoxic activity of *Grewia tenax*. Qualitative tests were also conducted for the presence of anthraquinone, amino acids, alkaloids, glycosides, carbohydrates, tannin, triterpenoids and saponin using ethanol, n-hexane, and hydro alcohol solvents for phytochemical extraction. Experiments suggested that n-hexane extract of *G. tenax* indicated maximum antioxidant bands whereas the plant indicated rich antioxidant properties with methanol extract (Basri *et al*., 2014). Aadesariya, *et al*., 2017 stated in their experimental studies based on two plants, namely *Grewia tenax* and *Abutilon pannosum* that dichloromethane (DCM) leaf extract of *G. tenax* showed much more medicinal activity than dichloromethane leaf extract of *Abutilon pannosum*. Leaves of *G. tenax* contain sterol lipids, alkaloids, fatty ester, fatty acid, carotene, glycoside, steroidal alkaloid, glycerophospholipids, sesquiterpenes, glycerophosphates, phosphatidylglycerol, sesquiterpenes, antifungal, antioxidant, antibacterial and antiviralactivity. From whole parts of *Grewia tenax* plant total eleven compounds were isolated from ethyl acetate soluble fraction for the antimicrobial activity and the compounds are (1) beta-sitosterol, (2) beta-sitosteryl acetate, (3) beta-amyrin, (4) beta-amyrin acetate, (5) 5 alpha,8 alpha-epidioxyergosta-6,22-diene-3 beta-ol, (6) 5 alpha,8 alpha-epidioxyergosta-6,9 (11), 22-trien-3 beta-ol, (7) alpha-taraxerol, (8) stigmasterol, (9) betulin (10) oleanolic acid and (11) stigmasterol 3-O-beta-D-glucoside (Ahmed *et al*., 2011).

Phytochemical analysis was conducted in leaves of *Grewia optiva* using acetone, chloroform, petroleum ether, methanol, benzene and water as comparative solvents for quantitative tests. It was observed that fixed oils and fats were found in acetone, benzene, petroleum ether, chloroform, water and methanol extract, amino acids and protein were found in methanol, acetone and water extracts whereas saponins were found in water and methanol extract. Although no significant antioxidant activity was found in acetone and methanol extract (Arora, 2011). However Anwar *et al*., 2015 reported that *Grewia optiva* contains flavonoid, phenols, saponins, tannins, terpenoids and alkaloids. Plant parts are used to cure many diseases like fever, diarrhea. *Grewia abutilifolia* is used in neurodegenerative disorders as well as in folk and traditional systems of medicines. Due to the presence of anticholinesterases activity, it is an important plant in the pharma industry for making drugs. The leaves of the plants contain steroids, terpenoids, saponins, tannins, flavonoids, carbohydrates, coumarins, alkaloids. (Rafe *et al*., 2018). HPLC analysis and paper chromatography was conducted for the quantification of carbohydrates. It was observed that 99.48% of the free sugars portion are present in eight constituents of sugar. Similarly, 88.47% and 92.24% free sugar portion are present in six sugars and hot polysaccharides constituents respectively (Zeid *et al*., 2015). Patil, *et al*., 2011 stated that leaves of *G. asiatica* demonstrate hypoglycemic action in ethanol extract. Furthermore, lipoidal and flavonoid contents were also calculated in leaves of *G. asiatica* by using various extracts (Zeid *et al*., 2005a; Zeid *et al*., 2005b). Chromatography techniques were used for the extraction of the oil from seeds of *G. bicolor* and found to display pharmaceutical, cosmetic and industrial importance (Nyakudya *et al*., 2015). It was observed that the though the oil content of the seeds was low, it is a good source of oleic, stearic, linoleic and palmitic acids and is used as an ingredient of soap, cosmetic products and drugs. Roots of *G. optiva* also exhibited anti-bacterial activity against Gram-negative and Gram-positive bacteria in methanol extracts (Arora, 2011; Shagal *et al*., 2012). Similarly methanolic extract of leaves of *G. tenax* had antimicrobial property against bacteria like *Bacillus sublilis*. Phenols and terpenoids were present in the methanol extract of stem and bark of this plant, whereas alkaloids were present in ethyl acetate extract but was unstable (Salma *et al*., 2017).

Several research works have been carried out in the field of pharmacology of this genus, but other important aspects are still unexplored and needs a thorough investigation. *Grewia* is prevalent in desert areas and is therefore thought to be drought tolerant and having importance in

traditional medicine system and economy of local tribes. Study of physiological and enzymological changes during drought can help us develop drought tolerant taxa by genetic transformation.

References

Aadesariya, M.K., Ram, V.R., Dave, P.N. (2017) Extraction, Isolation and Identification of Useful Phyto Constituents from Dichloromethane Leave Extract of *Abutilonpannosum* and *Grewia tenax* Using Q-TOF LC/MS. *Int J Adv Res Chem Sci* **4**: 1-14. doi: http://dx.doi.org/10.20431/2349-0403.0410001.

Ahaskar, M., Sharma, K.V., Singh, S., Sisodia, R. (2007) Radioprotective Effect of Fruit Extract of *Grewia asiatica* in Swiss Albino Mice Against Lethal Dose of γ-irradiation. *Asian J Exp Sci* **21**: 2.

Ahmed, E., Sharif, A., Hussain, S., Malik, A., Hassan, M., Munawar, M.A., Nagra, S.A., Anwar, J., Ashraf, M., Afza, N., Athar, M. (2011) Phytochemical and Antimicrobial Studies of *Grewia tenax*. *J Chem Soc Pak* **5**: 676-681.

Akhtar, M.S., Iqbal, Z., Khan, M.N., Lateef, M. (2000) Anthelmintic activity of medicinal plants with particular reference to their use in animals in the Indo-Pakistan subcontinent. *Small Ruminant Res* **38**: 99–107. doi.org/10.1016/S0921-4488(00)00163-2.

Ali, S.I., Khan, N.A., Husain, I. (1982) Flavone glucosides from the leaves of *Grewia asiatica*. *J Sci Res* **4**: 55-56.

Anand, J.C. (1960) Efficacy of sodium benzoate to control yeast fermentation in phalsa (*Grewia asiatica* L.) juice. Indian J Hort **17**: 138–141.

Anwar, J., Shah, H.M., Ali, R., Iqbal, Z., Khan, S.M., Rahman, I.U., Khan, S., Rehman, S., Shad, S., Sohail. (2015) Antioxidant activity and phytochemical screening of stem bark extracts of *Grewia optiva* Drummond ex Burret. *J Pharmacogn Phytochem* **3**: 179-182.

Aratanechemuge, Y., Hibasami, H., Sanpin, K., Katsuzaki, H., Imai, K., Komiya, T. (2004) Induction of Apoptosis by Lupeol Isolated from Mokumen (*Gossampinus malabarica* L. Merr.) in Human Promyelotic Leukemia HL-60 Cells. *Oncol Rep* **11**: 289-292. doi.org/10.3892/or.11.2.289.

Arora, S. (2011) Antibacterial, antifungal, antioxidant and phytochemical study on the leaves extract of *Grewia optiva*. *J Pharm Res* **4**: 3130-3132.

Badami, S., Gupta, M.K., Suresh, B. (2002) Pharmacognostical Evaluation of *Grewia tilifolia* Bark. *Indian J Nat Prod* **18**: 6 -11.

Baruah, U., & Ramakrishnan, P. S. (1989) Phenology of the shrub strata of successional sub-tropical humid forests of north-eastern India. *Vegetatio* **80**: 63-67.

Basri, T.S.J., Reddy, G.V.S., Jayaveera, K.N. (2014) A Study on Phytochemical and Antioxidant Activity of *Grewia tenax*. *Int J Pharm Res Bio-Sci* **3**: 703-710.

Bennet, S. S. R. (1985). Ethnobotanical studies in West Sikkim. *J Econ Taxon Bot* **7**: 317-321.

Bhakuni, D.S., Dhar, M.L., Dhar, M.M., Dhawan, B.N., Gupta, B., Srimal, R.C. (1971) Screening of Indian Plants for Biological Activity: Part III. *Indian J Exp Biol* **9**: 91-102.

Bita, A.M., Attibayeba, J.P., Kampe, L., Ngantsoue, Mialoundama, F. (2016) Propagation by Cutting of *Grewia coriacea* Mast. (Malvaceae). *Pak J Biol Sci* **19**: 36-42.

Brink, M. (2007) *Grewia bicolor*Juss. Protabase. PROTA Plant Resources of Tropical Africa. http://database.prota.org/search.htm. Accessed: June 2018.

Chakraborty, I., Mitra, S., Pathak, P. (2004) Potential underutilized tropical fruits of India. III International Symposium on Tropical and Subtropical Fruits. **864**: 61–68.

Chattopadhyay, S., Pakrashi, S.C. (1975) Indian medicinal plants. XXXIV. Triterpenes from *Grewia asiatica*. *J Ind Chem Sci* **52**: 553.

Connor, D.O., Ford, J. (2014) Increasing the Effectiveness of the "Great Green Wall" as an Adaptation to the Effects of Climate Change and Desertification in the Sahel. *Sustainability* **6**: 7142-7154. doi:10.3390/su6107142.

Dev, R., Sharma, G.K., Singh, T., Dayal, D., Sureshkumar, M. (2017) Distribution of *Grewia* species in Kachchh Gujarat, India: Taxonomy, Traditional Knowledge and Economic Potentialities. *Int J Pure Appl Biosci* **5**: 567-574. doi: http://dx.doi.org/10.18782/2320-7051.5000.

Dhar, M.L., Dhawan, B.N., Prasad, C.R., Rastogi, R.P., Singh, K.K., Tandon, J.S. (1974) Screening of Indian plants for biological activity: Part V. *Indian J Exp Biol* **12**: 512-523.

Dhyani, S. K., Narain, P. R. A. T. A. P., Singh, R. K. (1990) Studies on root distribution of five multipurpose tree species in Doon Valley, India. *Agrofor Syst* **12**: 149-161.

Farnsworth, N.R., Akerele, O., Bingel, A.S., Soejarto, D.D., Guo, Z.G. (1985) Medicinal plants in therapy. Bull WHO **63**: 965-981.

Gill, B.S., Khehra, S., Kaur, G., Singh, S. (2015) Effect of inorganic fertilizers on the plant growth and fruit quality in phalsa (*Grewiaasiatica* D.C.). *Adv Res J* **6**: 100-104. doi : 10.15740/ HAS/ ARJCI/ 6.2/100-104.

Hotez, P.J., Brindley, P.J., Bethony, J.M., King, C.H., Pearce, E.J., Jacobson, J. (2008) Helminth infections: the great neglected tropical diseases. *J Clin Investig* **118**: 1311-1321. https: //doi.org/ 10.1172/ JCI34261.

Jain, S.K., Tarafder, C.R. (1970) In: Duke J.A. 2004. Phytochemical and Ethnobotanical Database, USDA-ARS-NGRL, Beltsville Agriculture Research Center, Beltsville, Maryland Available at: http://www.ars-grin.gov/cgi-bin/duke/ethnobot.pl. Accessed: January 2018.

Jaspers, M.W.J.M., Bashir, A. K., Zwaving, J. H., Malingre, T. M. (1986) Investigation of *Grewia bicolor* Juss *J Ethnopharmacol* **17**: 205-211.

Joshi, M.C., Patel, M.B., Mehta, P.J. (1980) Some Folk Medicines of Dangs, Gujarat State. Bulletin of Medico- Ethno Botanical Research. **1**:8.

Khattab, H. A., El-Shitany, N. A., Abdallah, I. Z., Yousef, F. M., Alkreathy, H. M. (2015). Antihyperglycemic potential of *Grewia asiatica* fruit extract against streptozotocin-induced hyperglycemia in rats: anti-inflammatory and antioxidant mechanisms. *Oxid Med Cell* **2015** doi.org/10.1155/2015/54974.

Kirtikar, K.R., Basu, B.D. (1975) Indian Medicinal Plants, Basu LM and Co., Allahabad. **1**: 384.

Kumar, V.R., Venkatachalam, V.V. (2016) Physicochemical Evaluation and Phytochemical Investigation of the Leaves of *Grewia tiliaefolia Der Pharm Lett* **8**: 52-56.

Lakshmi, V., Agarwal, S.K., Chauhan, J.S. (1976) A new ä-lactone from the flowers of *Grewia asiatica*. *Phytochemistry* **15**: 1397–1399.

Lakshmi, V., Chauhan, J.S. (1976) Grewinol, a keto-alcohol from the flowers of *Grewia asiatica*. *Lloydia* **39**: 372–374.

Le Houerou, H.N. (1980) Browse in Africa. The current state of knowledge. Addis Ababa, Ethiopia.

Madiele, A.B., Zhao, J.M.Q., Thiery, V., Agnaniet, H., Brunet, C., Graber, M., Ouamba, J.M. (2015) Caracterisations analytiques des extraits colorants desplantestinctorialesd'Afrique Centrale. *Leban Sci J* **16**:41.

Marwat, S. K., Usman, K., Khakwani, A. A., Ghulam, S., Anwar, N., Sadiq, M., Khan, S. J. (2011). Medico-ethnobotanical studies of edible wild fruit plants species from the flora of north western Pakistan (DI Khan district). *J Med Plant Res* **5**(16): 3679-3686.

Morton, J.F. (1987) Phalsa, Fruits of warm climate. Julia Morton, Miami, F.L. 276.

Nandikar, M.D., Ravikumar, K. (2017) Neotypification and taxonomic reinstatement of *Grewia macrophylla* G. Don (Malvaceae-Grewioideae) *Taiwania* **62**: 299-304. doi: 10.6165/ tai.2017.62.299.

Nayak, K.G., Davidar, P. (2010) Pollination and breeding systems of woody plant species in tropical dry evergreen forests, southern India. *Flora* **205**: 745–753.

Ngantsoue, L., Attibayeba, F., Essamambo, Bolopo-Engagoye, Kaboulou, V. (2005) Germination of seeds and growth of young plants of *Grewia coriaces* Mast Ann. Univ. MarienNgouabi, **6**: 140–148.

Nyakudya, T.T., Nosenga, N., Chivandi, E., Erlwanger, K.H., Gundidza, M., Gundidza, E., Magwa, M. L., Muredzi, P. (2015) *Grewia bicolor* seed oil: Putative pharmaceutical, cosmetic and industrial uses. *S Afr J Bot* **97**: 154-158.

Orwa, C., Mutua, A., Kindt, R., Jamnadass, R., Simons, A. (2009) Agroforestry Database: A Tree Reference and Selection Guide Version 4.0. http://www.worldagroforestry.org/af/treedb. Accessed: April 2018.

Patil, P., Patel, M.M., Bhavsar, C.J. (2011) Preliminary Phytochemical and Hypoglycemic Activity of Leaves of *Grewia asiatica* L. *Res J Pharm Biol Chem. Sci.* **2**:516.

Paul, S. (2015) Pharmacological actions and potential uses of *Grewia asiatica*: A review. *Int J Appl* **1**: 222-228.

Pederson, K. (2009) Importance of Fruits in Diet. Available at: http://ezinearticles.com/? Importance-of-Fruits-in-Diet&id=139930. Accessed: May 2018.

Rafe, M.R., Salam, R., Hossain, M.M., Masud, M.M. (2018) Phytochemical Screening and Acetylcholinesterase and Butyrylcholinesterase Inhibitory and Thrombolytic Activities of *Grewia abutilifolia* Vent. &Juss. Leaf. *J Pharm Sci* **17**: 81-86.

Raghunathaiyar, S. (1996). Indian medicinal plants. *Hyderabad: Orient Longman*, 104-105.

Rao, M.G., Kumar, A.O. (2018) Antioxidant Activity of *Grewia villosa. J Integral Sci* **1**: 12-16.

Salma, H.A.A.A., Salih, Ahmed, O.E., Abdelhalim, A. (2017) Biological Activity and Phytochemical Profiling of *Grewia tenax* Stem Bark Extracts. *Int J Biol Pharm Allied Sci* **6**: 1181-1194.

Salunkhe, D.K., Desai, B.B. (1984) Phalsa. In: Salunkhe and Desai (eds.) Postharvest biotechnology of fruits. **1-2** CRC Press, Boca Raton, FL.

Shagal, M.H., Kubmarawa, D., Idi, Z. (2012) Phytochemical Screening and Antimicrobial Activity of Roots, Stem-bark and Leave extracts of *Grewia mollis*. *Afr J Biotechnol* **11**: 11350-11353. doi: 10.5897/AJB11.3938.

Sharma, K.V.,Sisodia, R. (2010) Hepatoprotective efficacy of *Grewia asiatica* fruit against oxidative stress in swiss albino mice *Iran J Radiat* **8**: 75-85.

Sharma, N., Patni, V. (2012) *Grewia tenax* (Frosk.) Fiori- A Traditional Medicinal Plant with Enormous Economic Prospectives. *Asian J Pharm Clin Res* **5**: 28-32.

Siddiqi, R., Naz, S., Sayeed, S.A., Ishteyaque, S., Haider, M.S., Tarar, O.M., Jamil, K. (2013) Antioxidant Potential of the Polyphenolics in *Grewia asiatica*, *Eugenia jambolana* and *Carissa carandas*. *J Agric Sci* **5**. doi:10.5539/jas.v5n3p217.

Sinha, J., Purwar, S., Chuhan, S.K., Rai, G. (2015) Nutritional and medicinal potential of *Grewia subinaequal* is DC. (syn. *G. asiatica*.) (Phalsa) *J Med Plant Res* **9**: 594-612. doi: 10.5897/JMPR2015.5724.

Sita, P., Moutsambote, J.M. (1988) Catalogue des plantesvasculaires du Congo. Brazzaville, pp.195.

Tan, J.B.L., Yap, W.J., Tan, S.Y., Lim, Y.Y., Lee, S.M. (2014) Antioxidant Content, Antioxidant activity and Antibacterial Activity of Five Plants from the Commelinaceae Family. *Antioxidants* **3**: 758-769. doi:10.3390/antiox3040758.

Thakur, P.S., Sood, R. (2005) Drought Tolerance of Multipurpose Agroforestry Tree Species during First and Second Summer Droughts after Transplanting. *Indian J Plant Physiol* **10**: 32-40.

Tripathi, P. (2009) Phalsa (*Grewia subinaequalis*) cultivation https://www.researchgate.net/publication/304765037.

Tripathi, S., Chaurey, M., Chaurey, Balasubramaniam, A., Balakrishnan, N. (2010) *Grewia asiatica* Linn. - As a Phytomedicine: A Review. *Research J Pharm and Tech* **3**: 1-3.

Ullah, W., Uddin, G., Siddiqui, B.S. (2012) Ethnic uses, pharmacological and phytochemical profile of genus. *J Asian Nat Prod Res* **14**: 186–195.

Wani, T.A., Pandith, S.A., Rana, S., Bhat, W.W., Dhar, N., Razdan, S., Chandra, S., Kitchlu, S., Sharma, N., Lattoo, S.K. (2015) Promiscuous Breeding Behaviour in Relation to Reproductive Success in *Grewia asiatica* L. (Malvaceae). *Flora* **211**: 62-71.

Zeid, A.A.H.S., Sleem, A.A. (2005a) Antidiabetic effect and flavonoids of *Grewia asiatica* leaves. Bulletin of Faculty of Pharmacy, Cairo University **43**: 137-145.

Zeid, A.A.H.S., Sleem, A.A. (2005b) Antihyperlipidemic effect and lipoidal constituents of *Grewia asiatica* leaves. Bulletin of NRC Egypt, Faculty of Pharmacy, Cairo University **30**: 557-573.

Zeid, A.H.A., Mohammed, R.S., Sleem, A.A. (2015) Biologically Active Polysaccharides from *Grewia asiatica* Linn. Leaves. *Int J Pharmacogn Phytochem* **7**: 1080-1087.

Zia-Ul-Haq, M., Stankoviæ, M. S., Rizwan, K., Feo, V. D. (2013) *Grewia asiatica* L., a food plant with multiple uses. *Molecules*, ***18***: 2663-2682. doi:10.3390/molecules18032663.