

PHYTOCHEMICAL AND PHARMACOLOGICAL PROPERTIES OF THE GENUS *GREWIA*: A REVIEW

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ABSTRACT

A number of species of genus *Grewia* have been used as medicinal agents to treat several disease. The large flowering plant genus *Grewia* is belongs to family Tiliaceae and reported for its medical importance. Various parts of different species exhibit different medicinal importance and yet to be phytochemically investigated. This review based on knowledge of traditional uses, chemistry, biological effects and toxicity of different species of this genus. Triterpenoids, steroids, glycosides, flavones, lignanes, phenolics, alkaloids, lactones and organic acids have been isolated from various species of this genus. The extract and preparation from various species exhibited various biological effects, e.g. antioxidant, anti-bacterial and analgesic effect.

Keywords: Activity, Flavonoids, *Grewia*, Steroid, Triterpenoid.

INTRODUCTION

The genus *Grewia* belongs to family Tiliaceae. This genus comprising shrubs and trees and is distributed in the warmer parts of the world. Nearly 40 species of this genus are found in India some of which are well known for their medicinal value¹⁻³.

Pharmacological properties

The different parts of different species of genus *Grewia* are used as folk medicine in the different part of globes. Diverse bioactivity studies on different species of genus *Grewia* have been reported. The roots of *G. abutilifolia* are applied to abscesses⁴. The fruit of *G. asiatica* is astringent and cooling. Infusion of bark is demulcent while leaves are used in pustular eruptions. Its root bark is used as a remedy for rheumatism. 50% Ethanolic extract of aerial parts of *G. asiatica* showed hypotensive activity while the aqueous extract of stem bark is reported to be antidiabetic⁵. Its seed extract and seed oil exhibited antifertility activity⁶. Fruit Extract of *G. asiatica* shows radioprotective Effect in Swiss Albino Mice Against Lethal Dose of γ -irradiation⁷. The fruit is astringent and stomachic. It is reported that unripe phalsa fruit alleviates inflammation and is administered in respiratory, cardiac and blood disorders, as well as in fever reduction⁸. Furthermore, infusion of the bark is given as a demulcent, febrifuge, and treatment for diarrhea. *Grewia asiatica* contains anthocyanin type cyanidin 3- glucoside⁹, vitamin C, minerals and dietary fibers etc¹⁰. The antioxidant properties of vitamin C are well known and anthocyanin has recently emerged as a powerful antioxidant. Pet. ether extract of *G. bicolor* is used for treating postulant skin lesions¹¹. *Grewia bicolor* is a part of Sudanese traditional medicine, and is used in the treatment of skin lesions and sometimes also as a tranquilizer¹². The three alkaloids, Harman, 6-methoxyharman, and 6-hydroxyharman, isolated from the methanol extract of this plant, have antibacterial properties¹². Chloroform extract of the aerial parts of *G. bilamellata* exhibited antimalarial activity against the D6 and W2 clones of *P. falciparum*¹³. *Grewia carpinifolia* is used in washing hair to remove and prevent lice. Ethanolic extract of stem bark of *G. elastica* showed CNS depressant activity¹⁴. Various parts of *G. hirsuta* are used in headache, eye complaints, sores and cholera while ethanolic extract of stem bark exhibited antiviral and diuretic activity^{5,15}. The leaves are useful in nose and eye diseases, treating splenic enlargement, piles, rheumatism and relieving joint pain while the roots are used in diarrhea, dysentery and as a dressing for wounds. The plant *G. microcos* is used for treating indigestion, eczema and itch, small pox, typhoid fever, dysentery and syphilitic ulceration of the mouth. *Grewia mollis* is known to be a strong fire-resistant. Various parts of the plant are used in food and medicine. In Nigeria, the stem bark powder or mucilage is used as a thickener in local cakes made from beans or corn flour commonly called "Kosai" and "Punkasau" in Hausa (Nigeria), respectively. The dried stem bark is ground and the powder mixed with beans or corn flour thereby enhancing the texture

of the food product¹⁶. The flowers and young shoots are sometimes used as a soup or sauce vegetable. The infusion of the bark obtained by cold or hot maceration in water is used in beating mud floors, or mixed with the mud or the walls of huts to give a smooth surface. The mucilaginous property of the bark or leaf is used in application to cuts and sores. The Yoruba in Nigeria use it medicinally at times of child birth¹⁶. Some findings demonstrated that the mucilage obtained from the stem bark can serve as a good binder in paracetamol formulations^{17,18}. Also the recent reports suggest that high concentration of stem bark in dietary exposure may cause some adverse effects, especially liver injury¹⁹. Phytochemical studies of *G. mollis* indicated the presence of tannins, saponins, flavonoids, glycosides, phenols, steroids and the absence of alkaloids in the leaves and stem bark²⁰ while their presence was revealed in the roots²¹. Crude methanolic extract of *G. mollis* exhibited antimicrobial activity²². Plant parts of *G. sapida* are used in ulcerated tongue, colic, wounds, cholera and dysentery¹⁻³. The roots of *G. sclerophylla* are prescribed in cough and irritable conditions of intestine and bladder, while its decoction is used as an emollient enema while alcoholic extract of aerial parts demonstrated anticancer activity²³ while that of *G. serrulata* showed anti-inflammatory activity¹⁵. The bark of *G. tiliaefolia* is used to heal wounds, cure kapha, vata, burning sensation, throat complaints, biliousness and disease of the nose and blood. It is also used in dysentery and externally employed to remove the irritation from cow-itch. Its wood in powder form is emetic and antidote to opium poisoning. In *G. tiliaefolia*, the ethanolic extract of aerial parts exhibited CNS depressant and diuretic activity while that of stem bark exhibited spermic and hypotensive activity¹⁵. The leaves of *G. umbellata* are used for treating cuts and wounds. The bark and roots of *Grewia tiliaefolia* are used to treat skin diseases, hypertension, ulcers and diarrhoea²⁴. Lupenol, isolated from this plant, is known to cause apoptosis in several cancer cells²⁵. The aerial parts of *G. umbellifera* exhibited CNS depressant, hypotensive and diuretic activities²⁶. The juice of fresh bark of *G. villosa* is used with water and sugar for gonorrhoea and urinary complaints and the roots is used in diarrhoea. Other parts of the plant are used in sores, wounds, cholera and dysentery^{1-3,27} while the stem extract of *G. villosa* was found to be active in KB cell culture²⁸. An extract of *Grewia villosa* extract is used in treatment of tuberculosis²⁹, and this plant is also known to contain harman alkaloids. Harman alkaloids belong to the class of β -carbolines and bind strongly to receptors in the brain and affect the CNS³⁰. The mucilage of bark of *Grewia tenax* is reported to possess bactericidal activity and is used in the treatment of tuberculosis in hilly areas. The decoction of wood is given in cough and pains¹⁻³. In Sudan, the roots are used for curing various skin diseases³¹. The ethanolic extract of the aerial parts was found to exhibit CNS depressant activity³². *Grewia tenax* (Forsk.) Fiori, *G. flavescens* Juss and *G. villosa* Willd fruits, when ripe, are either eaten fresh or left to dry for consumption at a later date. In Sudan, a drink is prepared by soaking the fruits over-night, and then they are hand pressed, sieved and sweetened. A light porridge is prepared by the addition of flour or custard to *Grewia*

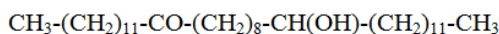
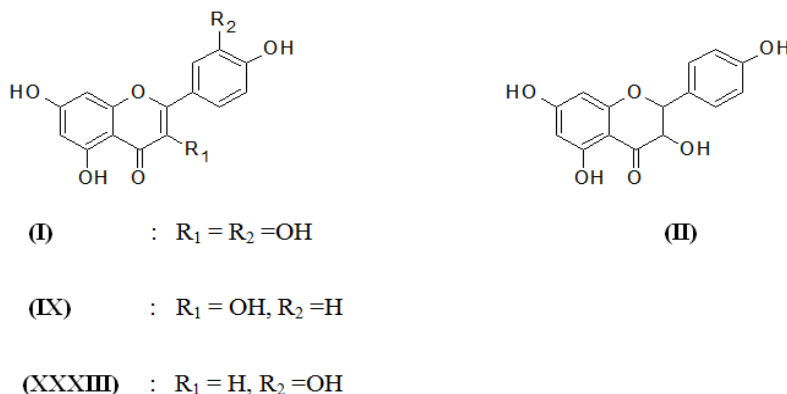
drink and served during the fasting month of Ramadan and is also fed to lactating mother to improve their health and lactating abilities. Moreover, the fruits are made into a fermented drink in Sudan and Southern Africa³³. *G. tenax* fruit was reported to contain large amounts of iron³⁴ and as such is used for treatment of anemia and malaria³⁵.

Phytochemical evaluation

Phytochemically, the genus *Grewia* has been found to possess mainly triterpenoids, fatty component, flavonoids, steroids, saponins and tannins. The compounds isolated from the various species are given in following table.

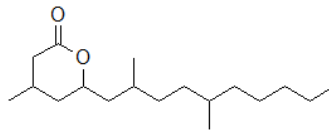
Table 1: Compounds isolated from genus *Grewia*.

Plant species	Plant part	Compounds isolated	References
<i>G. asiatica</i>	Flowers	Flavonoids: quercetin (I), quercetin-3-O-β-D-glucoside, naringenin (II) and naringenin-7-O-β-D-glucoside; grewinol (III), 3,21,24-trimethyl-5,7-dihydroxyhentriacontanoic acid δ-lactone (IV) and β-sitosterol	36-38
	Fruits	Flavonoids: quercetin (I), quercetin-3-O-β-D-glucoside and naringenin-7-O-β-D-glucoside; anthocyanins: pelargonidin-3,5-diglucoside (V), delphinidin-3-glucoside (VI) and cyanidin-3-glucoside (VII); and catechin (VIII)	39-41
	Leaves	Flavonoids: quercetin (I) and kaempferol (IX) and their glucosides	42
	Stem	Triterpenoids: taraxerol, erythrodiol (X), lupeol (XI), betulin (XII), lupenone, friedelin (XIII) and β-amyryn; β-sitosterol	43-45
<i>G. bicolor</i>	Whole plant	Triterpenoids: lupeol (XI) and betulin (XII); β-sitosterol and β-sitosterol-3-O-glucoside Alkaloids: Harman (XIV), 6-methoxyharman (XV) and 6-hydroxyharman (XVI)	11
<i>G. bilamellata</i>	Aerial parts	Coumarinolignans: grewin(XVII) and cleomiscosin D(XVIII); neolignans: nitidine(XIX) and bilagrewine(XX); triterpenoids: 3α,20-lupanediol (XXI) and 2α-3β-dihydroxy-olean-12-en-28-oic acid(XXII); pyran derivative: icariol A ₂ ; sterol: daucosterol; 8-O-4'-neolignanguaiacylglycerol-β-coniferyl ether; 2,6-dimethoxy-1-acetylquinol(XXIII) and ciwujiatone(XXIV)	13
<i>G. elyseoi</i>	Stem bark	Coumarinolignan : grewine(XVII)	46
<i>G. flavescens</i>	Roots	Triterpenoids: α-amyryn, β-amyryn, betulin(XII) and friedelin(XIII); triacontanol and β-sitosterol	47
<i>G. mollis</i>	Stem bark	Triterpenoids: α-amyryn, β-amyryn and erythrodiol(X); β-sitosterol	48
	Aerial parts	Flavonoids: Luteloin (XXV), 7-(1-O-β-D-galacturonide)-4'-(1-O-β-glucopyranosyl)-3',4',5,7-Tetrahydroxyflavone (XXVI), Triterpenoids: 7β-hydroxy-23-ene-deoxojessic acid (XXVII), 7β-hydroxy-23- deoxojessic acid (XXVIII), Steroids: β-Sitosterol, β-Sitosterol-3-O-glucoside (XXIX). Triterpenoid: lupeol(XI); leucoanthocyanidin(XXX)	21,22
<i>G. rothi</i>	Root bark	Triterpenoid: lupeol(XI); leucoanthocyanidin(XXX)	49
<i>G. tenax</i> syn. <i>G. populifolia</i>	Leaves	Triacontanol, tetratriacont-21-ol-12-one and β-sitosterol	50
	Seeds	Sterols: sitosterol and stigmasterol(XXXI)	51
	Stem bark	Triterpenoids: α-amyryn, β-amyryn, lupenone, erythrodiol(X) and betulin(XII); β-sitosterol and triacontanol	52,48
<i>G. tiliaefolia</i>	Roots	Triterpenoids: lupeol(XI) and friedelin(XIII)	53
	Stem bark	Triterpenoids: lupeol(XI), betulin(XII) and friedelin(XIII)	53,54
<i>G. tomentosa</i>	Whole plant	Tilioside(XXXII) and luteolin(XXXIII)	55

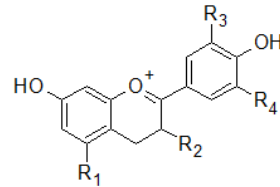
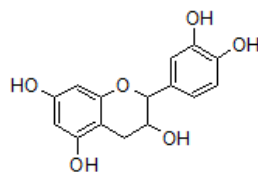


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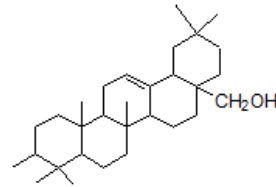
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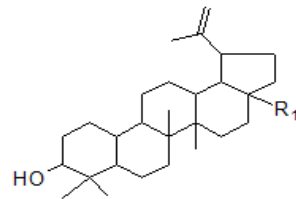
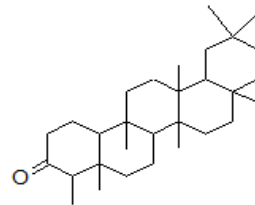
(IV)

(V) : $R_1 = R_2 = \text{Glc}$, $R_3 = R_4 = \text{H}$ (VI) : $R_1 = R_3 = R_4 = \text{H}$, $R_2 = \text{Glc}$ (VII) : $R_1 = R_3 = \text{OH}$, $R_2 = \text{Glc}$, $R_4 = \text{H}$ 

(VIII)



(X)

(XI) : $R_1 = \text{CH}_3$ (XII) : $R_1 = \text{CH}_2\text{OH}$ 

(XIII)

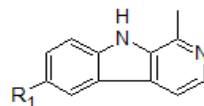
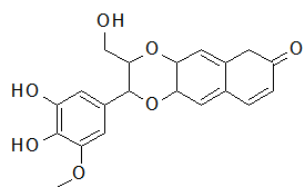
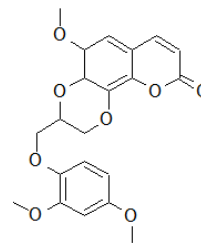
(XIV) : $R_1 = \text{H}$ (XV) : $R_1 = \text{OCH}_3$ (XVI) : $R_1 = \text{OH}$

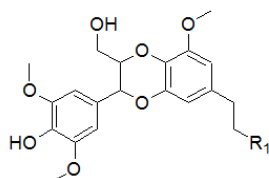
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(XVII)

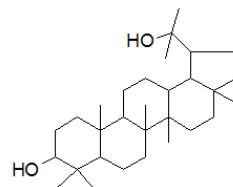


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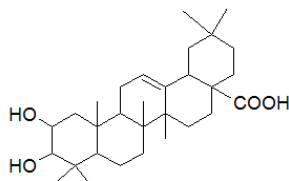


(XIX) : R₁ = CH₂OH

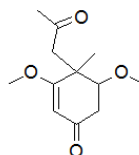
(XX) : R₁ = CHO



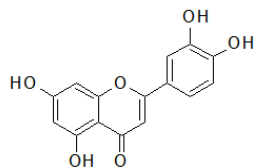
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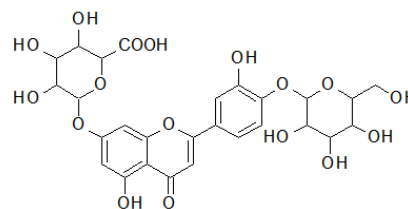
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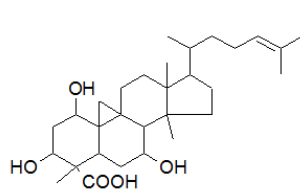
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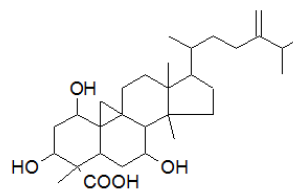
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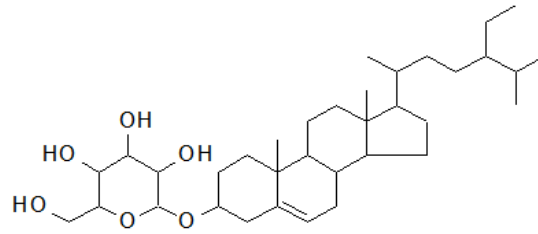


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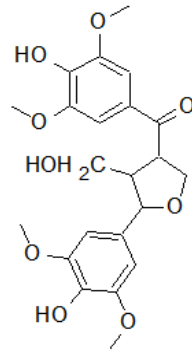


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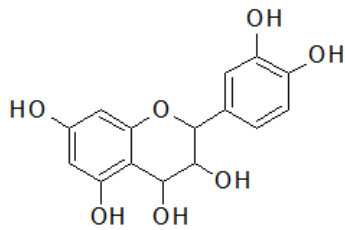
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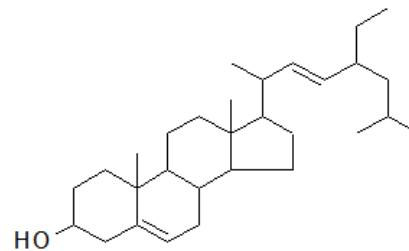
(XXIX)



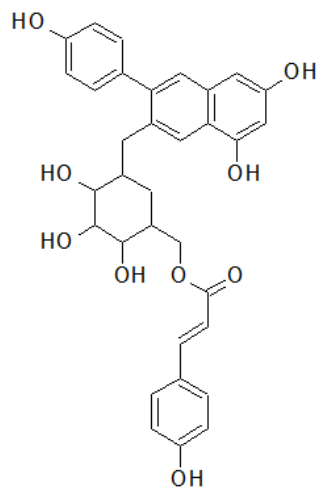
(XXX)



(XXIV)



(XXXI)



(XXXII)

Fig. 1: Structures of compounds isolated from the genus *Grewia*

CONCLUSION

Grewia, the versatile genus of medicinal plant is the unique source of various types of compounds having diverse chemical structure. A very little work has been done on the biological activity and possible medicinal application of its phytochemical. It is very useful traditional plant genus, crude extract from various part of various species have a therapeutic uses from time immemorial, so that some active constituent can developed for future studies. The global scenario is changing their face towards herbal medicinal uses due to less side effect and emphasis given to develop a modern drug to cure many acute disease. Therefore this review given to find out new activity or new entity responsible for various therapeutic activity.

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REFERENCES

- Kirtikar KR and Basu BD. Indian Medicinal Plants, Basu LM and Co., Allahabad, Vol. I, p. 384 (1975).
- The Wealth of India, Raw Materials and Industrial Products, CSIR, New Delhi, Vol. IV, p. 266 (1956).
- Chopra RN, Nayar SL and Chopra IC. Glossary of Indian Medicinal Plants. CSIR, New Delhi, p. 128 (1956).
- Joshi MC, Patel MB and Mehta PJ. Some folk medicines of Dangs, Gujarat State Bull. Med. Ethno. Bot. Res., 1980, 1: 8.
- Bhakuni DS, Dhar ML, Dhar MM, Dhawan BN, Gupta B and Srimal RC. Screening of Indian plants for biological activity: Part III; Indian J. Exp. Biol., 1971, 9: 91.
- Asolkar LV, Kakkar KK and Chakre OJ. *Indigofera tinctoria*. In: Second Supplement to Glossary of Indian Medicinal Plants with Active principles. New Delhi, Publication Information Directorate, 368 (1992).
- Ahaskar M, Sharma KV, Singh S and Sisodia R. Radioprotective Effect of Fruit Extract of *Grewia asiatica* in Swiss Albino Mice Against Lethal Dose of γ -irradiation, Asian J. Exp. Sci., 2007, 21: 2.
- Morton JF. Phalsa, Fruits of warm climate. Julia Morton, Miami, F.L. 276 (1987)
- Nair MG, Wang H, Mody DK and Deueitt DL. Dietary food supplement containing natural cyclooxygenase inhibitors and methods for inhibiting pain and inflammation. United states patent application (2005).
- Yadav AK. Phalsa: A Potential New Small Fruit for Georgia. J. anick. 1999, 348.
- Jaspers WJMM, Bashir AK, Zwerving JS and Malingre TM. Investigation of *Grewia bicolor* Juss., J. Ethnopharmacol., 1968, 17(3): 205.
- Jaspers WJMM, Bashir, A. K.; Zwaving, J. H.; Malingre, T. M. Investigation of *Grewia bicolor* Juss. J. Ethnopharm., 1986, 17: 205.
- Ma C, Zhang HJ, Teng G, Hung NV, Cuong NM, Soejarto DD and Fong HHS. Antimalarial compounds from *Grewia bilamellata* J. Nat. Prod., 2006, 69: 346.
- Bhakuni RS, Shukla YN and Thakur RS. Chemical constituents of *Melochia corchorifolia* Linn, Indian J. Chem., 1987, 26B: 1161.
- Dhawan BN, Patnaik GK, Singh KK and Tandon JS. Screening of Indian plants for biological activity : Part VI Indian J. Exp. Biol., 1977, 15: 208.
- Dalziel K. The useful plants of West Africa. Crown Agents, 41 Millbank, West minster, London, S.W.1. 98 (1937)
- Martins E, Christiana I and Olobayo K. Effect of *Grewia* gum on the mechanical properties of paracetamol tablet formulations. Afr. J. Pharm. Pharmacol., 2008, 2: 1.
- Muazu J, Musa H and Musa KY. Comparison, mechanical and release Properties of paracetamol tablets containing acid treated *Grewia* Gum, J. Pharmaceutical Sci. Technol. 2009, 1(2): 74.
- Obidah W, Godwin LJ and Fate ZJ. A Mike Madusolumuo.. Toxic Effects of *Grewia mollis* Stem Bark in Experimental Rats, Journal of American Science, 2010, 6(12): 1544.
- Onwuliri FC, Mawak JD, Wonang DL and Onwuliri EA. Phytochemical, toxicological and Histopathological studies of some medicinal plants in Nigeria, Int. J. Nat. Appl. Sci., 2006, 2(3): 225.
- Heinz R and Helene F. The isolation of 6-Methoxyharmane From *Grewia mollis*, Lloydia. 1978, 41(4): 383.
- Youssef HMA, Amina M and El-shafae AM. Biological evaluation of constituents from *Grewia mollis*, Journal of Chemical and Pharmaceutical Research, 2012, 4(1): 508.
- Dhawan BM, Dubey MP, Mehrotra BN, Rastogi RP and Tandon JS. Screening of Indian plants for biological activity : Part V. Indian J. Exp. Boil., 1980, 18: 594.
- Raghunathaiyar S. Indian Medicinal Plants 1996, 3: 104.
- Aratanechemuge Y, Hibasami H, Sanpin K, Katsuzaki H, Imai K and Komiya T, Induction of apoptosis by lupeol isolated from mokumen (*Gossampinus malabarica* L. Merr) in human promyelotic leukemia HL-60 cells. Oncol. Rep. 11, 289 (2004)
- Dhar ML, Dhar MM, Dhawan BN, Mehrotra BN, Srimal RC and Tandon JS. Screening of Indian plants for biological activity : Part XV Indian J. Exp. Biol., 1974, 12: 512.
- Jain SK and Tarafder CR. Medicinal Plant-Lore of the Sandals. Econ Bot., 24: 241-245, Econ. Bot., 1970, 24: 241.
- Hussein SM and Kingstar DGI. Screening of Plants Used in Sudan Folk Medicine for Antitumor Activity, Fitoterapia, 1981, 52: 281.
- Bashir AK, Ross MF and Turner TD. The alkaloids of *Grewia villosa* root, Fitoterapia, 1987, 58: 141.
- Pfau W and Skog K. Exposure to beta-carbolines norharman and harman. Journal of Chromatography B 2004, 802: 115.
- El-Kher YM and Salih MH. Investigation of certain plants used in Sudanese folk medicine Fitoterapia, 1980, 51: 143.
- Dhar ML, Dhar MM, Dhawan BN, Mehrotra BN, Srimal RC and Tandon JS, Screening of Indian plants for biological activity : Part IV Indian J. Exp. Biol., 1973, 11: 43.
- FAO/WHO, 1988. Requirements of vitamin A, iron, folate and vitamin B12. Report of a Joint FAO/WHO Expert Consultation. FAO Food Nutr. Ser. No. 23, Rome, FAO
- Maydell HJV. Trees and Shrubs of the Sahel. GTZ 6 MBH, Esborn, (1990)
- Sulieban MS and Eldoma AM. Marketing of Non-wood forest products (Excluding the Gum Arabic) in Sudan. Forest National Corporation (FNC). Ministry of Agriculture, Animal Wealth And Natural Resources- Khartoum, Sudan, pp: 3, 10, 20, 30 (1994)
- Laxmi V, Agarwal SK and Chauhan JS. A new δ -lactone from the flowers of *Grewia asiatica*, Phytochemistry, 1976, 15(9): 1397.
- Laxmi V and Chauhan JS. Grewinol, a keto-alcohol from the flowers of *Grewia asiatica*. Llyodia, 1976, 39(5): 372.
- Laxmi V and Chauhan JS. Chemical examination of the seeds of *Amomum subulatum* J. Indian Chem. Soc., 1976, 53(6): 633.
- Shrivastava HC. Paper chromatography of fruit juices. J. Sci. Ind. Research, 1953, 12B: 363.
- Agarwal S and Mishra K. New flavonoids from the *Grewia asiatica*, J. Indian Chem. Soc., 1979, 56(6): 649.
- Khurdiya DS and Anand JC. Anthocyanin derivatives from the fruits of *Grewia asiatica*, J. Food Sci. Technol., 1981, 18(3): 112.
- Ali SI, Khan NA and Husain I. Flavone glucosides from the leaves of *Grewia asiatica*, J. Sci. Res., 1982, 4(1): 55.
- Joshi KC, Prakash L and Shah RK. Chemical composition of stem of *Grewia asiatica*, J. Indian Chem. Soc., 1974, 51(9): 830.
- Chattopadhyaya S and Pakrashi SC. Triterpenoids from *Grewia asiatica*, J. Indian Chem. Soc., 1975, 52(6): 553.
- Tripathi VJ, Ray AB and Dasgupta B. Triterpenoid Constituents of *Grewia Asiatica*, Curr. Sci., 1973, 42(23): 820.
- Paris R. African Tiliaceae oxytocic; *Grewia elysei*, Ann. Pharm. France, 1956, 14: 348.
- Prakash L and Singh R. Chemical examination of *Grewia flavescens*, Pharmazie, 1981, 36(8): 576.
- Prakash L, Sharma NN and Goyal G. Chemical composition of *Grewia flavescens*, Indian J. Chem., 1979, 17B: 537.
- Bhagat S and Misra GS. Chemical constituents of *Grewia rothii*, J. Indian Chem. Soc., 1974, 12(9): 1018.
- Mukherjee KS, Bhattacharya MK and Ghosh PK. Phytochemical examination of *Grewia tenax*, J. Indian Chem. Soc., 1981, 58(8): 818.
- Ganguly SN, Bhattacharya AK and Ganguly G. Steroids from seeds of *Grewia tenax*, J. Indian Chem. Soc., 1966, 43: 453.
- Sarkar B and Khanna NM. Chemical examination of *Grewia tenax*, J. Sci. Ind. Res., 1959, 18C: 20

53. Anjaneyulu B, Babu V, Ganguly AK, Govindachari TR, Joshi BS, Kamat VN, Manmade AH, Mohamed PA, Rahimtula AD, Saxena AK, Varde DS and Viswanathan N. Chemical investigation of some Indian plants., Indian J. Chem., 1965, 3(5): 237.
54. Badami S, Gupta MK, Ramaswami S, Rai SR, Najanan M, Bendell DJ, Suffan RS and Bhojpal S. Determination of betulin in *Grewia tiliifolia* by HPTLC, J. Sep. Sci., 2004, 27(1-2): 129.
55. Yolk SY. Chemical constituents of *Grewia tomentosa*, Fac. Pharm. Paris, 1971, 56 (2): 87.