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REVIW ARTICLE

REVIEW ON KIRGANELIA RETICULATA

***Kharat AR, Tarkasband YS, Nambiar VV, Pujari RR**

Department of Pharmacognosy, Modern College of Pharmacy, (For Ladies), Moshi, Pune

**Corresponding Author's Email ID: dramolkharat@gmail.com*

ABSTRACT:

In the present review, an attempt has been made to congregate the botanical, phytochemical, pharmacological and information on *Kirganelia reticulata* (Poir) Family Euphorbiaceae, a medicinal herb used in the indigenous system of medicine. *K. reticulata* has been adored in almost all ancient ayurvedic texts for its extraordinary medicinal properties. *K. reticulata* is annual herbaceous climbing plant with long history of traditional medicinal uses in many countries especially in tropical and subtropical regions. Since ancient times the climber has been known for its curative properties and has utilized for treatment of various ailments including, diuretic, diarrhoea, small pox and astringent. Wild range of chemical compound including, flavanoids, triterpenoids, alkaloids and glycosides have been isolated from the species. Their extracts have been found to possess various pharmacological activities. A compressive review of its ethanomedical uses, chemical constituents, and pharmacological profile as a medicinal plant is prepared. Particular attention is given to its antibacterial, antiviral, hepatoprotective, hypoglycemic, anti-inflammatory activity, antioxidant effects so that its potential uses can be better evaluated. This review will definitely help for the researchers as well as clinicians dealing with *K. reticulata* to know its proper usage as this herb is seemed to be highly valuable, possessing many pharmacological / medicinal properties.

Keywords: Euphorbiaceae, Kirganelia reticulate, phytochemistry, Pharmacological properties

Key massage: The present review is on Kirganelia reticulate plant. The review mainly deals with the traditional uses,

INTRODUCTION

Herbal drugs have been used since ancient times as medicines for the treatment of a range of diseases. Medicinal plants have played a key role in world health. An increasing number of research papers and reviews clearly indicate that medicinal plants exhibit a variety of therapeutic properties and provide health security to rural people in primary health care [1] .India is a rich source of medicinal plants and a number of plant extracts are used against diseases in various systems of medicine such as ayurveda, unani and sidhha. Plant derived natural products such as flavonoids, terpenes, alkaloids have received considerable attention in recent years due to their diverse pharmacological properties including cytotoxic and cancer chemopreventive effects. [2-4]

Using herbs and plants for medicinal purposes has a long traditional. Medicinal herbs are significant source of synthetic and herbal drugs. In the commercial market, medicinal herbs are used as raw, drugs, extracts or tinctures. Isolated active constituents are used for applied research [5.] For the last few decades, Phytochemistry (study of plants) has been making rapid progress and herbal products are becoming popular. Plants derived compounds have a great significant to cancer therapy.[6,7] Many herbs were the starting point of important chemotherapeutic drugs. In explaining medicinal plants, Rigveda dates them back three year prior to existence of animal life on earth. This indicates the importance it attributed to medicinal plants.

Selecting right scientific and systematic approach to biological evaluation of plant products based on their use in traditional medicines is the key to ideal development new herbal drug from plant. The family Euphorbiaceae consists of about 283 genera and 7300 species. It is cosmopolitan in distribution, chiefly tropical but extending into temperate regions of Northern and Southern Hemisphere [8] Kirganelia reticulate (Poir) Baill. belongs to family Euphorbiaceae. The stem of this plant are long and slenderical in shape, It is broadly oval in shape, but has ridges and grooves, grows in all over india .Epidermis consists of medium sized barrel-shaped cells with outer thick walls and have thick cuticle outside followed from within by 2–3 layered collenchymas [9.] The leaves and bark are used as astringent and diuretic. Juice of leaves is used for the treatment of diarrhea in children. The medicinal plant has been used as folk medicine for several diseases like cancer, arthritis etc. [10, 11]

Plant Profile:

Kirganelia reticulate (Poir) (KR) is also known as Phyllanthus reticulatus (Poir).

Commons names: (Sanskrit): Krishna-Kaamboji, (Hindi): Bhuinowla, (Tamil): Abirangi, (Telugu): Nallapuli, (Marathi): Pavana, (Assam): Amluki. Geographically it occurs throughout India and now is cultivated in worldwide in a dry forest up to 800-meter height. It is generally accepted that KR indigenous to Africa and that it reached temperate and tropical area of Asia. [12]

BOTANICAL DESCRIPTION:

Morphology:

The plant are shrub or small tree to 5-10 m tall, monoecious, much baranched tree, leaves on main stems reduced to scales, bole up to 25 cm in diameter. Diciduous brachletes 7-20 cm long. With 10-20 leaves, axis glabrous or pubescent. Bark pale reddish brown color, longitudinally fissured; branches slender in shape, spreading and drooping almost to the ground, lateral leafy shoots are up to 25 cm long, pale grey or brownish white in color. Leaves are simple 1.3-3.2 by 0.8-2 cm, variable, oblong or elliptic, sometimes almost rotundate, obtuse or

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acute, thin glabrous or nearly so, pale beneath, base rounded, acute or subcordate; main nerves few, slender; petioles 1.5-3 mm. long, slender, stipules 1.5mm. long ,ovate, acute, sometimes bristle, pointed. Flowers in bisexual cymules, each with 1 female flower and 2-3 male flowers which were axillary, the males in fascicles of 2-6, the females solitary, pedicels 1.5-6 mm. long slender. Calyx glabrous, reaching 2.5mm. Long; segments oblong, very obtuse, alternating with the glands of the disk. Male flower: Stamens 5, unequal, the 3 inner connate into a column the 2 outer free, 0.5-1.2mm long, anthers erect vertically and shorter. Female flowers: ovary 5-10 –celled; ovules 2 in each cell, superposed; styles 3, very short, bilobed. Fruits are small, purple fleshy berry 4-6mm. diam., baccate, sub-globose, blackish or purplish color of fruits, smooth and shining. Seeds 8-10 (usually 10), irregularly 3-gonous seeds, 1.5-2mm long, nearly smooth, finely granulate. [13-16]

Genus: Kirganelia

Kirganelia is a large Genus comprising about 750 species in tropical and subtropical regions, with about 150 species in mainland tropical Africa and the Indian Ocean islands. [17, 18]

Growth and development

In the Sahel region flowering occurs towards the end of the dry season, shortly after the plants have come into leaf, and continues during the rainy season. In Sudan K. reticulate flowers in March–October and fruits in October–December. In southern Africa, it is reported to flower before or when coming into leaf, mainly in September–October, but flowering may start as early as July. The flowers have a very characteristic smell of potatoes. [13, 17-25]

Traditional Uses:

The whole plant is astringent, sweet, cooling, diuretic, alternant, stomachic, constipating and attenuant. It is reported to be useful in vitiated condition of pitta, burning sensation, strangury, gastropathy, ulemorrhagia, ophthalmodynia, sores, burns, suppuration, diarrhea, skin eruption, obesity, in inflammation bleeding gums, smallpox, and asthma. Leaves are employed as a diuretic and cooling medicine also leaves crush rubbed on body malaria patient. Fruits are to the bowels; useful in inflammations, vata and diseases of the blood (Ayurveda).[13, 26-30] Bark is considered alternative and attenuant, and is prescribed in decoction in the quantity of four ounces or more twice daily, used to treat rheumatism, dysentery venereal diseases. Stem are used to cure eyes, the juice as eye drops from them being blown into eyes to cure conjunctivitis and soreness. Powdered root is sprinkled on infected wounds and chancre. The stem and leaves are rubbed on the chest against asthma; a leaf decoction is drink to treat a sore throat, against snakebites, mental problems and diarrhoea. The Asante people in Ghana give a soup made of K. reticulate leaves boiled with palm oil to women after childbirth. [31-32]

Commercial Applications:

In Sudan and East Africa, a red or black dye is obtained from the fruit, bark and roots of K. reticulate plant; it is used for tanning and dyeing fishing lines and nets the mixture of crushed leaves and black mud is used traditionally to dye cloth. [33-37, 41] In Indonesia, a decoction of stems and leaves is used for dyeing cotton black. It was also used as a mordant. In India, the root is reported to produce a red dye. In the Philippines, a black ink is prepared from the ripe fruits. Stems are used in Nigeria as roof binders. Twigs are widely used as chew sticks. The wood is suitable for local construction and as firewood or tinder; it produces charcoal of good quality. In Tanzania, it is used to make flails for threshing, utensils and other small objects and was formerly used in fire-drills. Timber: the wood is sometimes used to make utensils. [38-40]

Phytochemistry:

Phytochemical investigation of the stem bark of K.reticulate afforded pentacosane, 21 α-hydroxyfriedelan-3-one, taraxerol, 1 up-20(29)-en-3 β-24-diol, β-sitosterol and β - sitosterol- β-D-glucoside. The ethanolic extract was found to exhibit significant antiviral activity against poliomyelitis and measles, moderate antifungal activity.[41-45] Eight compounds (β-Sitosterol-3-O-β-glucoside, stigmasterol-3-O-β-glucoside, methyl gallate, ellagic acid, corilagin, methyl brevifolincarboxylate, kaempferol and astragalin), including two flavonoid glycosides rutin (quercetin 3-rutinoside) and quercetin 3- O- β –D-glucopyranoside (isoquercitrin), were isolated from the butanol-soluble fraction of the methanolic extract of the leaves of K.reticulate by conventional method.[46-49] Besides plant of this genus are reported to contains lignans, flavanoids, triterpenoids, alkaloids, Polyphenolic compound. The three compounds were isolated and identified as lupeol acetate, stigmasterol and lupeol. [50-55] The isolation of chemical compound components carried out using different chromatographic techniques and structure of compound were elucidated by spectroscopic method including NMR and mass spectroscopy.[56-59.]

PHARMACOLOGICAL PROPERTIES:

All plant parts traditionally used in treatment of rheumatism, diabetic, small pox, asthma, diarrhoea; stems are used to treat sore eyes.

Antibacterial Activity

The agar-well diffusion and broth dilution method using susceptibility of some gram-negative organisms (escherichia coli, pseudomonas aeruginosa, and salmonella typhi) and gram-positive organism (staphylococcus aureus) evaluated the antibacterial activity. It was tested; determine the minimum antibacterial activity against all the tested microorganisms. Antibacterial activity performed on crude methanolic, chloroform and hexane extracts of the leaves of K.reticulate. Screening of crude extracts showed notable minimum inhibitory concentration (MIC) and minimum bactericidal concentration (MBC) at concentrations of 100 to 6.25 mg/ml-1. Organisms are more sensitive to methanolic extract of leaves. [60, 61]

Antiviral Activity

P.reticulatus is a reputed medicinal plant used for the treatment of gastric complaints including colic, constipation etc. To evaluate the antiviral activity of this plant against hepatitis B virus (HBV) using HBsAg positive serum sample from hepatitis B virus infected patients. Two semi-purified organic fractions designated as PR1 and PR2 of the fat free ethanolic extract were tested at

both lower and higher concentrations (20 mg/ml and 40 mg/ml respectively) for their anti hepatitis B virus surface antigen (anti-HBsAg) activity using an in vitro system by reverse Passive Haemagglutination (R-PHA) method. SERRODIA-Anti-HBsAg-Diagnostic kit was used for detection of Anti-HBsAg antibody. Both fractions showed anti-HBsAg activity. But it was found the fractions have little inhibitory action on HBsAg at lower concentration where as at the higher concentration they have prominent inhibitory action on the antigen. To the best of our knowledge this is the first report of the antiviral activity of P. reticulatus against HBV. The Anti-HBsAg activity observed by the fractions may be due to the binding of the agents with the antibody binding sites present on HBsAg. Thus the fractions might be the potential sources of the active principles responsible for antiviral activity. [62,63]

Hepatoprotective Activity

Aerial parts of P. reticulatus were two partially purified organic fractions designated by PR1 and PR2 of the fat free ethanol (95%) extracts tested for the hepatoprotective activity in rats against CCl4-induced liver damage. The rats receiving the fractions showed promising hepatoprotective activity as evident from significant changes of pentobarbital-induced sleeping time, changes in serum levels of sGPT, sGOT, sALP and bilirubin and from histopathological changes as compared to CCl4-intoxicated rats. [64, 65]

Hypoglycemic Activity

The plant P.reticulates is reported to have hypoglycemic activity in tribal area. The petroleum ether and ethanolic extracts of roots of the plant orally tested at doses of 500 and 1000mg/kg for hypoglycemic effect in alloxan induces diabetic mice. It showed very good hypoglycemic activity at the dose of 1000mg/kg. [66]

Hypolipidemic activity

The hypolipidemic effects of aqueous and methanolic extract of P. reticulatus in poloxamer-407 induced hyperlipidemic rats. The hypolipidemic activity of extracts in the dose of 500 and 750 mg/kg body weight of rats was carried out in comparison with a lipid lowering standard drug Atorvastatin (0.4 mg/kg). The extracts and atorvastatin supplementation significantly lowered the total cholesterol ($P<0.001$), triglyceride ($P<0.001$) and atherogenic index ($P<0.001$) when compared with the control group. A marked increase in HDL level was also observed. The extracts showed a promising lipid lowering activity in hyperlipidemic rats. [67-70]

Antioxidant Activity:

Fruits of K.reticulate, extracted with methanol were get anthocyanin; they belongs to major flavanoids classes like flavones, isoflavones, flavonones ,anthocyanin which shows major antioxidant activity. In this study evaluates anthocyanin content, total phenols and analyzes antioxidant activity by enzymatic and non enzymatic methods. K.reticulate was found to have high concentration; glucose-6-phosphate dehydrogenase shows higher activity. Anthocyanins are becoming increasingly important not only as a plant pigment but also as food colorant. Pigments shows many therapeutic benefits including vasoprotective, anti inflammatory, anticancer properties and reversing age related deficits. [71,72]

Rheumatoid Arthritis:

The possible interactions were investigated used herbal medicine under RA Rheumatoid arthritis between plant isolates and synthetic drugs. K.reticulate, traditionally used to treat rheumatism was searched for its bioactive compounds. There are several compounds identified. Among them Scopoletin, Methyl brevifolin, Methyl gallate, Ellagic acid, Kaempferol and Quercetin followed Lipinski's rule of 5. Naproxen, which is an available NSAID, was used as a standard drug. RBP-J is a protein involved in both molecular pathways Notch and Toll-like receptor, was selected as a therapeutic target to RA. Based on binding energy (-7.65) and number of hydrogen bonds formed in the docking process Ellagic acid was considered to be efficient in comparison with Naproxen. Interaction between herbal medicine and synthetic drugs is a potentially important safety issue. Patients taking NSAID's, DMARD's are at the highest risk. [73, 74]

In Vitro Anti –Arthritic Property

Anti-arthritic activities on methanol and chloroform extracts of dried leaves of K. reticulata at 100µg/ml and 250µg/ml were used for the study. Methanol extract of K. reticulata leaf at 250µg produced significant activity whereas 100µg dose did not produce significant results, which was followed by chloroform extracts, when compared with the standard drug acetyl salicylic acid. Production of auto-antigens in certain rheumatic diseases may be due to in vivo denaturation of proteins. Since the membrane of RBC is structurally similar to the lysosomal membrane, the effect of any substance on stabilization of RBC membrane may be extrapolated to the stabilization of lysosomal membrane. [75]

Antinociceptive and Anti-Hyperglycemic Activity

The antinociceptive and anti-hyperglycemic activity of methanolic leaf extract of *P.reticulatus* was investigated in Swiss albino mice. A model of acetic acid-induced gastric pain in mice was utilized to determine the antinociceptive effects, and anti-hyperglycaemic activity was determined through glucose tolerance test using glucose-loaded mice. In writhing assays induced by acetic acid, the methanolic leaf extract showed significant inhibition compared to control. The maximum writhing inhibition (39.1%) was found at a dose of 200 mg extract/kg body weight which, however, was lesser than that of the antinociceptive drug, aspirin (50.4%), when used at a dose of 200 mg/kg body weight. Dose-dependent and significant anti-hyperglycaemic activity of the extract was found in mice loaded with glucose at extract doses of 100, 200 and 400 mg extract/kg body weight. Maximum tolerance (35.0%) was showed at 400 mg extract/kg body weight, compared to that of the standard drug, glibenclamide at 10 mg/kg body weight (57.8%). the methanol extract of P. reticulatus leaves had beneficial effects as a pain reliever and in reducing the elevated blood glucose level of hyperglycemic mice. [76, 77]

Analgesic and Anti-Inflammatory

Evaluated ethyl acetate and methanol extracts of P.reticulatus for analgesic and anti-inflammatory activity.

In the acetic acid-induced writhing test, the ethyl acetate extract in doses of 150 and 300 mg/kg showed 51.23 and 65.12% inhibition of writhing, respectively. A significant elongation of tail-flick time was evident both in the ethyl acetate and in the methanol extracts (42.38 and 60.49%) only at the 300 mg/kg dose level. In carrageenan-induced rat paw edema model, the methanol extract at the 300 mg/kg dose level showed 40.03% inhibition of edema at the end of 4 h. the extracts of P. reticulatus. Possess significant analgesic and anti-inflammatory activity. [78-81]

CONCLUSION

K.reticulata is a well-known plant used in ISM, in addition folk medicine also claims uses especially in cardiac, diabetic, cancer etc. Recently K.reticulate plant has become widely used in not only India but also Thialand, Shrilanka, Chaina, other many countries for it culinary and medicinal uses. It is very important in a number of diseases for which they are considerable scientific reports and data. Chemically K.reticulate contains various biological active phytoconstituents including flavanoid, triterpines, alkaloids, phytosterol. It may thus be considered an important gift from ayurveda to mankind.

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REFERENCE:

1. Shanthy S, Verma SK, Dwivedi P, In Vitro Cytotoxic Activity of Indian Medicinal Plants Used Traditionally To Treat Cancer, Asian J Pharm Clinical Res, 2011, 4(1), 27.
2. Ramalingam R, Sivakumar T, In vitro and In vivo anti-cancer activity of leaves of *Plumeria alba* Linn, Pharmacy Res, 2009, 2(2), 203-207.
3. Kumar A, Singh A, Review on *Hibiscus rosa sinensis*, Int J Res In Pharm Biome Sci, 2012, 3(2), 534-538.
4. Thakur HA, Patil DA, Petiole anatomy of Some Unstudied Euphorbiaceae, J Phytology, 2011, 2(12), 54-59.
5. Gopinath SM, Sylvester, *Phyllanthus amarus*, *Phyllanthus reticulatus* of Siddarabetta, Tumkur district, Karnataka, Inter J Pharmacognosy and Phytoche Res, 2012, 4(3), 109-111.
6. Pandey G, Madhuri SP, Harmacological activities of *ocimum sanctum* (tulsi): a review, Inter J Pharmaceutical Sci Review and Res, 2010, 5(1): 61-66.
7. Ahuja G, Bharti R, Sileima Y, Shruthi SD, In Vitro Anti-Arthritic activities of Leaf extracts from *Kirganelia Reticulata Bail*, Deccan J. of Natural Product, 2012, 3(1), 1-7.
8. IDMA. Indian Herbal Pharmacopoeia. Mumbai, India: 2002. P. 272.
9. Shah CS, Qadry JS, A Text Book of Pharmacognosy,India: 1998. P. 216.
10. Pavala RN, Moorthi C, Senthamarai, Kathiresan K, A Study to Explore The Pharmacognostic and Phytochemical Screening of Artemisia Nilagirica Leaves Found In Nilgiris District of Tamil Nadu. Intern J Pharmacy and Pharmaceutical Sci 2012, 4(4), 441-447.
11. Kirtikar KR, Basu BD. Indian medicinal plants. Vol 3rd 2nd ed. India: B Singh and M.P. Singh Publishers, 1980. P.345.
12. The Wealth of India, Raw Materials. Vol-5. Council of Scientific and Industrial Research, New Delhi: 2001, P. 320-321.
13. Unander DW, Webster GL, Blumberg BS. Records of usage or assays in Phyllanthus (Euphorbiaceae) l. Subgenera Isocladus, Kirganella, Cicca and Emblica, J Ethnopharmacology, 1990, 30, 233–264.
14. The Useful Plants of India. Council of Scientific & Industrial Research. New Delhi: 1992. P. 309
15. Phytochemical investigation of certain plant use in ayurveda. Central council for research in ayurveda & siddha, New Delhi: 1990, P. 203.
16. Khare CP. Indian medicinal plants. All illustrated Dictionary. Springer Pvt, Ltd. India,:2007. P. 354.
17. Agrawal SS, Paridhavi M, Herbal Drugs Technology. India universities press, India: 2007 P. 1-7.
18. Chopra RN, Nayar SL, Chapora IC, Glossary of Indian Medicinal Plants, CSIR, 2nd Edn. New Delhi, India: 1956.
19. Yognarasimham SN, Medicinal Plants of India. Vol 1. Interline Publishing Pvt. Ltd. Karnataka, India: 1996, P.275
20. Nadkarni KM. Indian Materis Medica. Vol 2. City publishers. 1982. P. 948.
21. Westra LY, Th Jifke KN, Wood atlas of the Euphorbicaeae s, IAWA Journal, 2004, 110(4 Suppl 1),1-84.
22. Grady LW, A Revision of Phyllanthus (Euphorbiaceae) in Eastern Melanesia, Pacific Science, 1986, 40, 1-4.
23. Nozeran R, Rossignolbancilhon L, Mangenot G, Studies on the genus *Phyllanthus* (Euphorbiaceae) - latest developments and perspectives, Bot Helv, 1984, 94, 199–233.
24. Mohammed R, Rashedul I, Zahirul K, Haru, Rownak J, Rahima B, Syeda S, Afsana K, Chowdhury AR, Folk Medicinal Practices in Vasu Bihar Village, Bogra District, Bangladesh, American-Eurasian J Sustainable Agriculture, 2010, 4(1), 86-93.
25. WHO. Quality control methods for medicinal plant material. Geneva: Organisation Mondiale De La Sante, 1992, P. 22-34.
26. Kokate CK, Practical pharmacognosy. 1st ed. New Delhi: Vallabh prakashan, 2007, P. 10-14.
27. Pullaiah T, Encyclopaedia of World medicinal plants. Vol-3, New Delhi: Regency publications, P. 1514-1515.
28. Balakrishnan, NP, Chakrabarty T, The family Euphorbiaceae in India; a synopsis of its profile, taxonomy and bibliography, 2007.P.346
29. Manimegalai M, Umavathi S. Effect of *Kirganelia reticulata* (Euphorbiaceae) Plant Extract Against The Growth and Development of The Human Filarial Vector Culex Quinquefasciatus (Diptera: Culicidae).EM intern 2010, 29(3), 413-416..
30. Balaji K, Subramanian RB, Inamdar JA, Occurrence of laticifers in *Kirganelia reticulata* (Poir.) Baill. (Euphorbiaceae), Phytomorphology, 1996, 46 (1), 81-84.
31. Traditional Plant Remedies among the Kondh of District Dhenkanal Orissa, 1994, 32(3), 274-283.
32. Datta SK, Datta PC. Histo-pharmacognostic study of *Kirganelia reticulata* (Poir.) Baill. stem bark. Bull. bot. Soc. Bengal. *Phyllanthus* Bark, Euphorbiaceae, Drug plants Medicinal plants Pharmacognosy Materia medica, 1980, 34, 89-93
33. Van Holthoon FL. Phyllanthus L. In: de Padua, L.S., Bunyapraphatsara, N. & Lemmens, R.H.M.J. (Editors). Plant Resources of South-East Asia No 12(1). Medicinal and poisonous plants 1. Backhuys Publishers, Leiden, Netherlands. 1999. P. 381–39.
34. Neuwinger HD, African traditional medicine: a dictionary of plant use and applications. Medpharm Scientific, Stuttgart, Germany: 2000. P. 589.
35. Radcliffe-Smith A. Euphorbiaceae, Part 1. In: Polhill, R.M. (Editor). Flora of Tropical East Africa. A.A. Balkema, Rotterdam, Netherlands. 1987. P. 407.
36. Radcliffe-Smith A. Euphorbiaceae, subfamilies Phyllantoideae, Oldfieldioideae, Acalyphoideae, Crotonoideae and Euphorbioideae, tribe Hippomaneae. In: Pope, G.V. (Editor). Flora Zambesiaca. Royal Botanic Gardens, Kew, Richmond, United Kingdom: 1996, 9(4), 1–337.
37. Calixto JB, Santos AR, Cechinel-Filho V, Yunes RA, A review of the plants of the genus *Phyllanthus:* their chemistry, pharmacology and therapeutic potential. Medicinal Research Reviews, 1998, 18(4), 225–258.
38. Newman DJ, Cragg GM, Snader KM, Natural products as sources of new drugs over the period 1981–2002, J Nat Prod, 2003, 66 , 1022-1037.

39. Renuka J, Alam S, Rekha A, Jain SC, Phytochemistry and bioactivity of *Kirganelia reticulata*, J Med Aromat Plant Sci, 1998, 20, 740–74.
40. Jain SC, Jain R, Alam S, Arora R, Phytochemistry and Bioactivity of *Kirganelia reticulata*, J Med Arom Plant Sci, 1998, 20(3), 740-741.
41. Shruti SD, Rajeswari A, Govardhan RK, Pavani A, Vedamurthy AB, Phytochemical & Antioxidants Analysis of Leaf Extract From *Kirganelia reticulata* Baill, Inet J Pharmacy Pharmaceutical sci, 2012, 4(3), 608-612.
42. Joshi KC, Singh P, Mehta A, Crystalline components of the roots of *Phyllanthus reticulantus*, J Ind Chem Soc, 1991, 58,102.
43. Jain R, Nagpal S, Chemical constituents of the roots of *Kirganelia reticulata*, J Indian Chem Society, 2002,79(9), 776-777.
44. Begum T, Mohammad SR, Mohammad SR, Phytochemical and Biological Investigation of *Phyllanthus reticulantus*, Dhaka Univ J Sci, 2006, 5(1-2), 21-23.
45. Hui WH, MM Li, KM Wong, A New compound, 21-a- Hydroxy Friedel-4, 23-En-3-one and other Triterpenoids from *Phyllanthus reticulates*, Phytochemistry, 1976, 15, 797-798.
46. Anjenenlu ASR, Jagonmohon R, Subraamanyam C, Isolation and Structural eluciladation of three new lignans from the leave *of Phyllanthus niruri* Linn, Tetrahedron, 1973, 29,129.
47. Yshida T, Seno K, Takama Y, Okanda T, Tannins and related polyphenol of Euphorbiaceous plants, Phytochemistry, 1982, 21, 1180.
48. Lam Sio Hong, Wang Chen Yu, Chen Chien Kuang, Chemical Investigation of Phyllanthus reticulatus by HPLCSPE-NMR and Conventional methods, Phytochem Anal, 2007, 18, 251-255.
49. Rav MR, Siddiqui HH, Screening of Indian plants for biological activity, Indian J Eaxperimental Bio, 1996, 2, 49.
50. Satyanarayana P, Subrohmanyan P, Viswanathan KN, New seco- and Lignans from *Phyllanthus niruri*, J Nat Prod,1988, 51,44-49.
51. Mahbuba K, Mirajum, Abdul Q, Sterols and Sterol Glucoside from *Phyllanthus* Species. Dhaka Univ J Sci. 2012, 60(1), 5-10.
52. Pojchaijongdee NU, Sotanaphun S, Limsirichaikul, Poobrasert O. Geraniinic acid derivative from the leaves of *Phyllanthus reticulates*, Pharmaceutical Biology, 2010, 48, 740-744.
53. Orient Longman, Indian medicinal plants, a compendium of 500 species. 2003; 4: P.264.
54. ICMR, Medicinal Plants of India. Indian council of medicinal research. New Delhi: 1987. 2: P. 407.
55. Jamal AK, Yaacob WA, Din LB, A chemical study on Phyllanthus reticulates, J physical sci, 2008, 19(2),45-50.
56. Samantaray S, Rout GR, Das P, Studies on the uptake of heavy metals by various plant species on chromite minespoils in sub-tropical regions of India, Environmental Monitoring and Assessment, 1999, 55(3), 389–399.
57. Sampanpanish P, Khaodhiar S, Pongsapich W, Khan E, Alternative for chromium removal: phytoremediation and biosorption with weed plant species in Thailand, Science Asia, 2007, 33(3), 353–362.
58. Lee SKY, Li PT, Lau DTW, Yung PP, Kong RYC, Fong WF. Phylogeny of medicinal *Phyllanthus* species in China based on nuclear ITS and chloroplast atpB-rbcL sequences and multiplex PCR detection assay analysis, Planta Medica, 2006, 72(8), 721–726.
59. Shruti SD, Ramchandra YL, Rai RS, Veena SA, Antibacterial potential of leaf extrarct from *Kirganelia reticulata* Baill, Int J pham Res dev, 2010, 2(6),1-6.
60. Rai PS, Shruthi SD, Ramachandra L, Isolation, Characterization, Antibacterial, Antihelminthic, and in Silico Studies of Polyprenol from *Kirganelia Reticulata* Baill, Medicinal Chemistry Research, 2012, 21 (11), 3-10
61. Das BK, Mohammad S, Pavel AM, Bhattacharjee R, Anti Hepatitis B Viral Activity of *Phyllanthus reticulates*, Bangladesh Pharm J, 2011, 14(1), 11-14.
62. Otto RG. Use of *Phyllanthus* constituents for treating or preventing infection caused by hepatitis B- viruses. United state patent application publication. 2007.
63. Das BK, Bepary S, Bidyut K.D, Chowdhury AK, Ali MS, Hepatoprotective Activity of *Phyllanthus reticulates*, Pak J Pharm Sci, 2008, 21(4), 333-337.
64. Adewusi EA, Afolayan AJ, A review of natural products with Hepatoprotective activity, J Med Plants Res, 2010, 4(13), 1318-1334.
65. Kumar S, Kumar D, Desmukh R.R, Rangari VD, Hypoglycemic activity of roots of *Phyllanthus reticulatus* in alloxan induced diabetic mice, Inter J Plant Sci, 2007, 2(1),184-187.
66. Ram, H. N. A.; Shreedhara CS, Gajera PF, Zanwar BS, Hypolipidemic activity of *Phyllanthus reticulatus* extracts in poloxamer-407 induced hyperlipidemic rats. Biomed 2009, 4(4),366-371.
67. Joshi KS, Gajera K P, Gajera FP, Ram HN, Hypolipidemic activity of methanolic extract of Phyllanthus *reticulatus* Poir In Triton-1339 induced hyperlipidemic rats, IPCA, 2008, 4-8, 95.
68. Gajera KP, Gajera FP, Zanwar S and Ram HN. Hypolipidemic effect of methanolic extract of *Phyllanthus reticulatus* Poir. in normal and high-fat diet fed rats in, IPCA, 2008, 4-7, 94.
69. Maruthappan V, Sakthi KS, Effects of *Phyllanthus reticulatus* on lipid profile and oxidative stress in hypercholesterolemic albino rats, Indian J Pharmacolog, 2010, 42(6), 388-391.
70. Shivsankar V, Moorthi A, Kannan SD, Suganya DP, Anthocyanin and its antioxidant properties in selected fruits, J Pharmacy Res, 2011, 4(3),800-806.
71. Ram AH, Shreedhara CS, Gajera FP and Zanwar SB, Antioxident studies of aqueous extract of *Phyllanthus reticulatus* poir, Pharmacologyonline, 2008, 1,351-364.
72. Shruthi SD, Ramachandra YL, RBP-J Therapeutic Target to Rheumatoid Arthritis- An Silico Study. Inter , Periclinical and Pharmaceutical Res, 2011, 2(1), 38-44.
73. Udayakumar Mani, Raguraman R, Rajagopalan SK, APMP-a web database for active principles in Indian medicinal plants, Drug Discovery 2013, 3(8), 20-23.
74. Ahuja G, Bharti R, Sileima Y, Shruthi SD, In Vitro Anti-Arthritic activities of Leaf extracts from *Kirganelia reticulata* Baill, Deccan J Natural Product, 2012, 3(1), 1-7.
75. Rahmatullah M, Ghosh KC, Mamun AA, Hossain MT, A Pharmacological Study on Antinociceptive and Anti-hyperglycemic Effects of Methanol Extract of Leaves of *Phyllanthus reticulatus* Poir. In Swiss Albino Mice, Advances in Natural and Applied Sci, 2010, 4(3), 229-232.
76. Mohammed R, Ghosh KC, Abdullah AM, Tozammal H, Salman A, A Pharmacological Study on Antinociceptive and Anti-hyperglycemic Effects of Methanol Extract of Leaves of *Phyllanthus reticulatus* Poir. In Swiss Albino Mice, Advances in Natural and Applied Sci, 2010, 4(3), 229-232.
77. Saha A, Mohammad A, Masud, Sitesh C. et al.,The Analgesic and Anti-Inflammatory Activities of the Extracts of *Phyllanthus reticulatus* in Mice Model, Pharmaceutical Biology, 2007,45,355-359.
78. Kumar S, Sharma S, Kumar D, Kumar T, Arya R, Kumar K, Pharmacognostic study and anti - inflammatory activity of *Phyllanthus reticulatus* Poir. Fruit, Asian Pacific J Tropical Disease, 2012, 332-335.
79. Kumar GP, Chaturvedi A, Anti-inflammatory screening of some medicinal plants of Euphorbiaceae, Phytological Res, 2005, 18 (2), 239-241.
80. Patel J, Gaudani R. Evaluation of Anti-inflammatory activity of Petroleum ether and Methanolic extract of *Phyllanthus reticulatus* leaves. J Advanced Pharmacy Edu & Res 2011. 1(6), 266-270.
81. Satyavati GV, Gupta AK, Tandon N, Seth SD. Medicinal Plants of India, Vol- 2, Published by Indian Council of Medicinal Research, New Delhi: 1987. P.118.

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