

AN OVERVIEW OF *DELONIX REGIA*: CHEMISTRY AND PHARMACOLOGICAL PROFILE

Jameel Ahmed¹, S.A.Nirmal*¹, R.A.Rub², S.K.Budhavale³ and S.R. Pattan⁴

¹Department of Pharmacognosy, Pravara Rural College of Pharmacy, Pravaranagar, Loni, M.S., India

²Department of Pharmacognosy, Allana College of Pharmacy, Pune, M.S., India

³Department of Pharmacognosy, Rajghad Dnyanapeeth College of Pharmacy, Bhor, Pune, M.S., India

⁴Department of Pharmaceutical Chemistry, Pravara Rural College of Pharmacy, Pravaranagar, Loni, M.S., India

Summary

Delonix regia (Caesalpiniaceae) has been used widely as medicine in Ayurveda. The chemical constituents reported from this plant belong to different classes such as carbohydrates, amino acids, tannins, flavonoids, phytosterols, alkanes, esters, and anthocyanin pigments. It has number of medicinal uses, many of which have been verified by scientific methods. This review article summarizes the chemistry and pharmacological profile of *D. regia*.

Keywords: *Delonix regia*, antioxidant, antimicrobial, antifungal, analgesic, anti-inflammatory, larvicidal, ovicidal, anthocyanins, carotenoids, zeaxanthins and lectin.

* Address for correspondence to:

Mr. Sunil Ashokrao Nirmal

Head, Department of Pharmacognosy,
Pravara Rural College of Pharmacy, Pravaranagar,
A/P-Loni, Tal- Rahata, Dist. - Ahmednagar

Pin- 413736, Maharashtra, India.

Phone: +91 9226564894

E-mail address: nirmalsunil@rediffmail.com

Introduction

Delonix regia (Caesalpiniaceae) is a stirringly ornamental medium sized tree planted in garden in all the warmer and damper part of India, native to Madagascar. It is commonly known as Gulmohar (Hindi) and flamboyant or Royal Poinciana (English). Leaves are abruptly bipinnate, subulate and quickly caduceus. Leaflets are small and are many in number. This aptly named tree produces striking flame-like scarlet and yellow flowers. Petals are five, orbicular, imbricate clawed, sub equal or the uppermost dissimilar and margin is fimbriate. Stamens are ten, ovary is sub- sessile and many-ovulated. Pod is elongated, flat, woody and dehiscent. Seeds are transverse oblong¹. Bark contain leucocyanidin, lupeol, tannin, β -sitosterol and free OH-proline as major amino acid and is used as antiperiodic and febrifuge. Flower anthers are a rich source of zeaxanthin. Its aqueous and alcoholic extracts were active against roundworm. Leaves contain tannins, lupeol and β -sitosterol. Plant is used as antirheumatic and spasmogenic.²

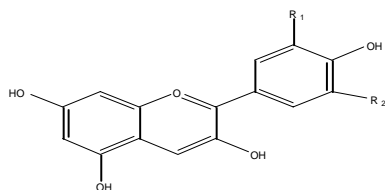
Chemistry

Various chemical constituents isolated from different parts of the plant *D. regia*, have been given in table-I and structures of some of the constituents are given in Fig. I.

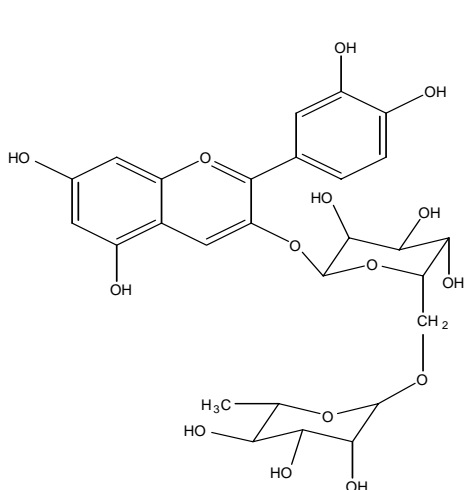
Table I: Phytoconstituents of *Delonix regia*.

Plant part investigated	Chemical constituents isolated	References
Flower	Anthocyanins, Cyanidine 3-o-glucoside, Cyanidine 3-o-rutinoside, Pelargonidine3-o-rutinoside, Zeaxanthin, Carotenoids and Natural dyes.	17 18 19 20
Floral parts	1,2-Benzene dicarboxylic acid.	21
Seeds	Lectin, Fatty acid, Protein and free amino acid.	22 23 24
Fruit	Activated Carbon	25
Misc.	Phytotoxins-4-hydroxybenzoic acid, Chlorogenic acid, 3,4-dihydrobenzoic acid, Gallic acid, 3,4-dihydroxycinnamic acid, 3,5-dinitrobenzoic acid, L-azetidine-2-carboxylic acid and 3,4-dihydroxybenzaldehyde. L-Azetidine-2-carboxylic acid and Amino acids.	26 27

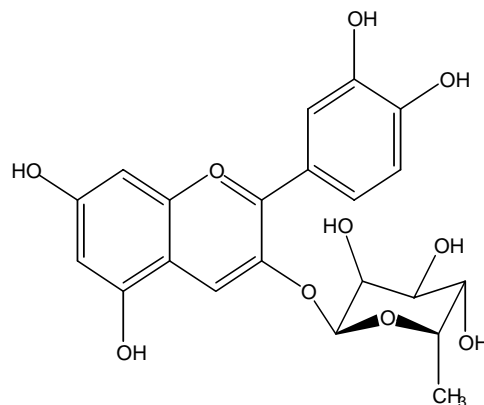
Figure I: Structures of Chemical Constituents.



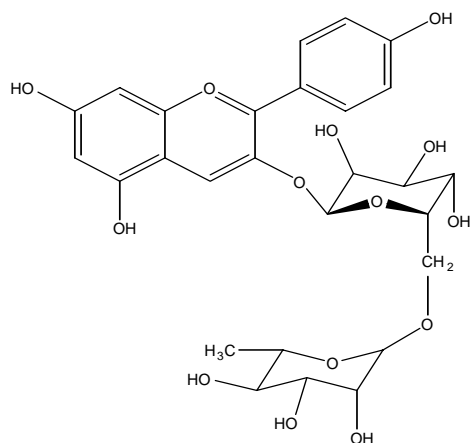
Anthocyanins



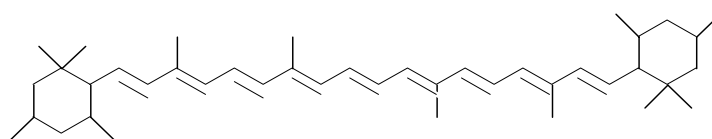
Cyanidine 3-o-glucoside



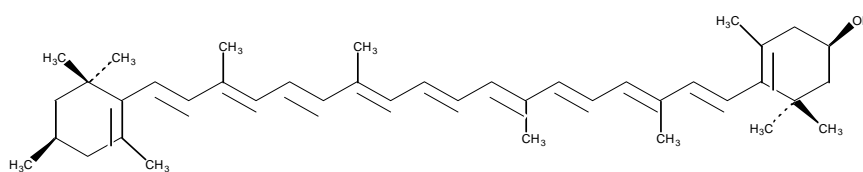
Cyanidine 3-o-rutinoside



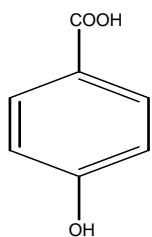
Pelargonidine 3-o- rutinoside



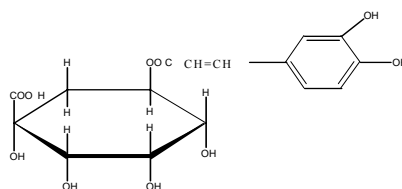
Caroténoides



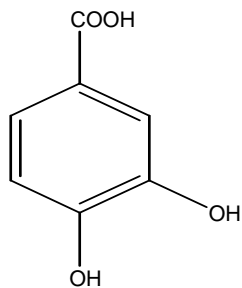
Zeaxanthin



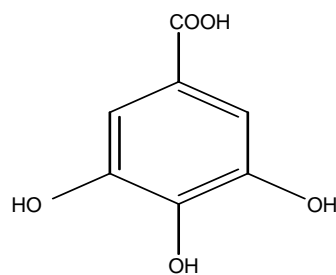
Phytotoxins 4-hydroxybenzoic acid



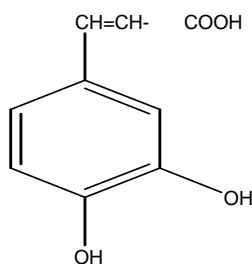
Chlorogenic acid



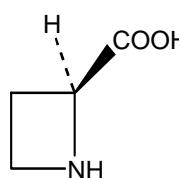
3. 4-dihydroxy benzoic acid



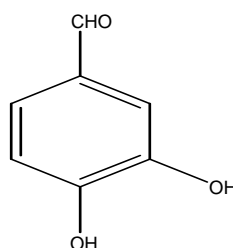
Gallic Acid



3. 4-dihydroxy cinnamic acid



Azetidine-2-carboxylic acid



3, 4-dihydroxy benzaldehyde

PHARMACOLOGICAL ACTIVITY

Antimicrobial activity:

Aqueous extract of *D.regia* plant exhibited marked activity against species of *Aspergillus* such as *A. candidus*, *A.columnaris*, *A.laviceps*, *A.fumigatus*, *A.niger*, *A.ochraceus* and *A.tamarii*.³ Crude alcoholic extract and fractions of *D.regia* (flowers) exhibited broad spectrum antibacterial and antifungal activities and potency was tested against nine bacteria, six filamentous fungi and a yeast *Candida albicans* by agar diffusion method. MIC was found in the range of 4.5-12.5 mg/ml against *C. albicans*.⁴ Aqueous and methanolic extract of *D.regia* plant was evaluated on bacterial strains like *Bacillus cereus* (ATCC11778), *Staphylococcus aureus* (ATCC25923), *Enterobacter aerogenes* ATCC13048, *Escherichia coli* (ATCC25922) and *Klebsellia pneumoniae* (NCIM2719). The significant antibacterial activity of active extracts, piperacillin (100 µg/disc) and gentamicin (10 µg/disc).⁵ Aqueous and methanolic extract of *D.regia* L. plant shows antibacterial activity against bacterial strains, namely *Bacillus subtilis* (ATCC6633), *Staphylococcus epidermis* (ATCC12228), *Pseudomonas pseudologicaligens* (ATCC17440), *Proteus vulgaris* (NCTC8313) and *Salmonella typhimurium* (ATCC23564) was determined by agar disk diffusion and agar well diffusion method.⁶ Ethanolic extract of *D.elata* and *D.regia* have shown good antimicrobial activity (40 mg/10ml).analgesic activity at the dose of 200 mg/kg body weight.⁷ Ethanolic extract and some fractions of *D.regia* (flowers) showed a broad spectrum of antibacterial activity with an inhibition zone size of 11 mm to 27 mm, against all the test bacteria. Antibacterial activity was observed in acetone and in the methanol fractions.⁸ Acetone and methanol fractions of *D.regia* (flowers) was located for antimicrobial activity and showed broad spectrum antibacterial activity against all (MRSA) strains with inhibition zone size of 11 mm to 27 mm.⁴ Invitro efficacy of bioactive extracts of 15 medicinal plants against ESβL-producing multidrug-resistant enteric bacteria.⁹

Antioxidant and Free Radical Scavenging Properties

Methanolic crude extracts of *D.regia* was screened for their antioxidant and free radical scavenging properties using α -tocopherol and butylated hydroxyl toluene as standard antioxidant, measured by ferric thiocyanate (FTC) assay and compared with the thiobarbituric acid (TBA) method. Free radical scavenging activity was evaluated using diphenyl picryl hydrazyl (DPPH) radicals. The extract showed significant antioxidant activity.¹⁰ Alcoholic extract of *D.regia* plant showed the potential antioxidant activity by FTC method, using α -tocopherol and Butylated hydroxyl toluene (BHT) as standard antioxidant.¹¹

Anti-inflammatory and Analgesic activities:

Analgesic activity at the dose of 200 mg/kg body weight.⁷ The extract of *D.regia* bark, and *D.regia* flowers used at the dose rate of 300 mg/kg, p.o. Aspirin (300 mg/kg, p.o.) was employed as a reference drug which exhibited significant anti-inflammatory activity, were also tested for analgesic activity, using Randall-Selitto method in rats.¹²

Larvicidal activity:

The extracts of *D.regia* was effective at higher concentrations showed larvicidal effect was tested against third and fourth instar larvae of *Culax quinquefasciatus*.¹³ Flower extracts of *D.regia* showed the percentage of hatching of eggs was significantly reduced. It is also highly toxic to larvae and pupae. Third instar larvae are more susceptible to extract than final instar larvae. The adult emergence from the treated pupae was completely inhibited at a concentration of 200 ppm.¹⁴

Inhibition of Tomato Spotted Wilt Virus:

The extract of *D.regia* showed high percentage (about 85 percent) of inhibition of T.S.W. virus.¹⁵

Nutritional and Haemagglutination properties:

The Haemagglutinating activity of the seed extract of *D.regia* plant was evaluated against a range of animal and human erythrocytes by a serial dilution method Nutritional performance of rats fed upon diets containing seeds was achieved without expensive pre-treatment of the seeds or for supplementation of the diets with individual amino acids. These seeds of *D.regia* contained only low levels of essentially non-toxic lectin and they have great potential for development as source of dietary protein for man and animals.¹⁶

References

1. Kirtikar KR, Basu BD. Indian Medicinal Plants 2nd Ed., Vol.III, Dehradun, 1987; 1193.
2. Khare CP. Indian Medicinal Plants, Springer International Ed., 2009; 205,206.
3. Satish S, Mohana DC, Raghavendra MP, Raveesha KA. Antifungal activity of some plant extracts against important seed borne pathogens of *aspergillus* sp. J. Agri. Techn., 2007; 3(1): 109-119.
4. Ahmed I, Aqil F. Broad Spectrum antibacterial and antifungal activities and potency of crude alcoholic extract and fractions of *Delonix regia* Flowers. 2nd world congress on Biotechnological Developments of Herbal Medicine NBRI Lucknow, Feb-2003; 20-22: 74
5. Parekh J, Sumitra V Chanda. In vitro Antimicrobial activity and Phytochemical Analysis of some Indian Medicinal Plants .Turk J. Biol. 2007; 31: 53-58.
6. Parekh J, Darshana, Jadeja, Sumitra V Chanda. Efficacy of Aqueous and Methanol Extract of some Medicinal Plants for potential Antibacterial activity. Turk J. Biol. 2005; 29: 203-210.
7. Seetharam, YN, Sharmabasappa VG, Murthy NS, Sangamma YR. Antimicrobial activity of *Delonix elata* and *Delonix regia* Raf. Aryavaidyan. 2002; V.16 (1): 51-53

8. Aqil F, Khan MS, Owais M. Ahmed I. Effect of certain Bioactive Plant Extracts on Clinical isolates of Beta-lactamase producing Methicillin resistant *Staphylococcus aureus*. J. Basic Microb. 2002; 25, 45(2): 106-14.
9. Iqbal Ahmed, Farrukh Aqil. Invitro efficacy of bioactive extracts of 15 Medicinal Plants against ESBL-Producing Multidrug-resistant enteric bacteria. Microb. Research. July 2007; v.162, issue 3, 27: 264-275.
10. Farrukh Aqil, Iqbal Ahmed, Zafar Mehmood. Antioxidant and Free Radical Scavenging Properties of Twelve Traditionally used Indian Medicinal Plants. Turk J. Biol. 2006;3:177-183
11. Aqil F, Mehmood Z, Ahmed I. Antioxidant properties of extracts and fractions of Chicory, Tulsi and gulmohar. 2nd World Congress on Biotechnological Developments of Herbal Medicine NBRI, Lucknow Feb 2003; 20-22: 130.
12. Muruganandam S, Srinivasan K, Tandan SK, Jawarlal, Suresh Chandra, Raviprakash V. Anti-inflammatory and Analgesic activities of some medicinal and aromatic plants. J. Medicinal and Aromatic plant sciences. 2000; v.22 (1): 32.
13. Chockalingam S, Thenmozhi S Sundari MSN. Larvicidal activity of different products against mosquito larvae. J. Env. Biol. 1990; v.11 (2): 101-104.
14. Chockalingam S, Manoharan T, Shankar kumar U. Ovicidal, Larvicidal and Pupicidal activities of an indigenous plant extract against *Pericallia recini*. J. Env. Biol..1992; v.13(3): 197-199.
15. Velazahan R, Narayanasamy P. Inhibition of Tomato Spotted Wilt Virus (TSW) by Plant Extract. Science and Culture. 1991; v.57 (5, 6): 141-142.
16. Grant G, More LJ, McKenzie NH, Doeard PM, Stewart JC, Telek L, Pusztai. A Survey of the Nutritional and Haemagglutination properties of several tropical seeds. Livestock Research for Rural Development. Dec 1991; Vol-3: 3.
17. Felix Adje, Yes F, Lozano, Emmanuelle Meude C, Paul Lozano, Augustin Adima, Georges Agbo NZi, Emile Gaydou M. Anthocyanin characterization of Pilot Plant Water Extracts of *Delonix regia* Flowers. Molecules. 2008; 13: 1238-1245
18. Barua RK, Barua AB. Oxidation of Zeaxanthin. Biochem. J. 1966; 101: 250-255
19. Jungalwala FB, Cama HR. Carotenoids in *Delonix regia* (Gulmohar) Flower. Biochem J. 1962; 1: 85.
20. Purohit A, Mallick S, Nayak A, Das NB, Nanda B, Sahoo S. Developing Multiple Natural Dyes from Flower parts of Gulmohar. Current Science. June 2007; v.92: 12, 25.
21. Ignacimuthu S. Inhibitory effects of allelopathic substances from parts of *Delonix regia* (Boj) Raf. Indian National Science Academy. 1997; v.63, B (6): 537.
22. Pando SC, Macedo MLR, Freire MGM, Toyama MH, Novello JC, Marangoni S. Biochemical characterization of Lectin from *Delonix regia* seeds. J. Protien Chemistry. Springer Publication. May 2002; v.21, no.4 (7): 279-285.
23. Adam Devra, Akleshwar Mathur, Sindal RS, Sherwani MRK. Chemical Examination of Wild Plant Seed oils from Aril Land of Rajasthan. Oriental J. Chem..2006; v.21: 2.
24. Qadry JS, Ali M. Protien Bound and Free Amino Acid Composition of Some Medicinal plant. Intern. J. Toxicology. 1991; v.1 (1): 236.
25. Mohammad Masbahuddin Hawaldar, Quazi Sohel Hussain, Sarwaruddin Choudhry AM, Mustafa AI, Motallib MA. Activated Carbon from Krishnachurna Fruit (*Delonix regia*) and Castor seed (*Ricinus communis* L.). Ind. J. Chem. techn. 1991; v.6, no.3: 146-151
26. Chang-Hung Chou, Lih-Ling Leu Allelopathic Substances and interactions of *Delonix regia* (Boj) Raf. J. Chem. Ecology. Springer Netherlands Publisher. Dec 1992; v.18, no.12: 2285-2303
27. Namdeo AG, Jadhav TS, Rai PK, Gavali S, Mahadik KR. Precursor feeding for enhanced production of secondary metabolites. Pharmacognosy Reviews. Jul-Dec 2007; v.1: 2.