Journal of Pharmacognosy and Phytochemistry
Available online at www.phytojournal.com

E-ISSN: 2278-4136
P-ISSN: 2349-8234
www.phytojournal.com
JPP 2021; 10(1): 01-06
Received: 15-10-2020
Accepted: 02-12-2020

Kunal
Department of Pharmaceutical Sciences, Maharshi Dayanand University, Rohtak, Haryana, India

Vishal
Department of Pharmaceutical Sciences, Maharshi Dayanand University, Rohtak, Haryana, India

Chhavi Singla
Department of Pharmacy, School of Health Sciences, Sushant University erstwhile Ansal University, Gurugram, Haryana, India

Asha Sharma
Department of Botany, Maharshi Dayanand University, Rohtak, Haryana, India

Anju Dhiman
Department of Pharmaceutical Sciences, Maharshi Dayanand University, Rohtak, Haryana, India

Corresponding Author:
Anju Dhiman
Department of Pharmaceutical Sciences, Maharshi Dayanand University, Rohtak, Haryana, India

An update on phytochemistry and therapeutic properties of *Ipomoea carnea*

Kunal, Vishal, Chhavi Singla, Asha Sharma and Anju Dhiman

Abstract
The genus Ipomea includes a large number of species and found everywhere around road side, waste land, canal land etc. *Ipomea carnea* (family: Convolvulaceae) is erect, woody, hairy, and slight cylindrical in shape, greenish in color which grows up to 6m on terrestrial land. It is popularly known as bush morning glory or beshram. The stem part of *I. carnea*. Contain alternate leaves. In Ayurveda, Siddha and Unani system of medicine, this plant is used as a folk medicine and literature reveals that *I. carnea* possess potential anti oxidant activity, immuno-stimulant, anti-cancer, hepato-protective and many other pharmacological activities. Chemical constituents of *I. carnea* are 2-ethyl-1,3-dimethylbenzene, 2-(12-pentadecynyloxy)tetrahydro2H-pyran, 3-furanyl[2-hydroxy-4-methyl-2--(2-methylpropyl)cyclopentyl]-methanone, 2,2-dideuterooctadecanal, hexadecanoic acid, Linoleic acid etc. After exhaustive literature survey, it may be concluded that *I. carnea* can be a considered as a safe, economic and potential medicinal plant for the treatment in many diseased conditions and may be explored by incorporating its active component(s)/extract(s)/fraction(s) in suitable drug delivery system(s) for therapeutic benefits.

Keywords: Diseases, folk medicine, immuno-stimulant, *Ipomoea carnea* L.

Introduction
Ipomoea carnea, also known as 'Bush Morning Glory' belonging to family Convolvulaceae [1] is a twining herb or shrub with milky sap. Worldwide, there are about 85 genera and 2,800 species in genus Ipomoea, which is the largest among Convolvulaceae family [2]. *I. carnea* is widely distributed all over the world, as in American tropics, Argentina, Brazil, Bolivia, Pakistan, Srilanka etc. [3- 8] However, in India, it is found only in two states *viz.* Chhattisgarh and Madhya Pradesh. [9] In Egypt, firstly it was cultivated as an ornamental plant, however, it is found everywhere nowadays, for example, on road side, canal bank, cultivated land, waste land etc. [10] It is also cultivated in some parts of China, Hainan, Guangxi as well as Taiwan [11].

I. carnea is used for its medicinal and ornamental properties. The latex of this plant shows anti-inflammatory effects, therefore, used as an antiseptic for treating lesions in traditional medicines [12]. Hot water extract of this plant shows anti-rheumatic property, and it also reduces teratogenic effect of cyclophosphamide [13]. It is also believed to show aphrodisiac, purgative and cathartic activity [14]. Various studies shows that this plant also exhibit antimicrobial and antifungal activities [15]. It has been reported that leaves of *I. carnea* can also be used in the treatment of piles and rheumatic pain [16] It also exhibit sedative and anticonvulsant property [17]. Papers can also be made by using its stem part. [18] Aqueous extract of *I. carnea* leaves exhibit harmful effects on embryo of rats which results in large amount of abnormalities and malformations. [19] In goats it has been reported induce intoxication which resulted in depression, muscle tremors, ataxia, etc. [20] The whole plant of *I. carnea* L. Is ahown in Figure 1 and the floral parts are shown in Figure 2.

Fig 1: Aerial parts of *Ipomoea carnea*

Fig 2: *Ipomoea carnea* flowers

Morphological characters

Ipomoea carnea grows up to a height of 6 m, but may acquire a shorter height in the aquatic habitats. After growing for some year, the stem becomes thick and converts into thick trunk and with several thick branches arising from the base. Leaf is simple and petiolate. Petiole is cylindrical, attains 4.0 - 7.5 cm length and 2.5 – 3.0 mmdiameter [21].

The stem of *Ipomoea carnea* is erect, woody, hairy, and more or less cylindrical in shape and greenish in color. Plant also contains alternate leaves. Normally its leaves attain 1.25 - 2.75 m length and 0.5 - 0.8 cm diameter. The leaves are light green, heart shaped or somewhat lanceolate and 10-25 cm long [22].

The plants bloom in clusters of 4 inch pink flowers throughout spring and summer. Its flowers are axial with green pedicel and cylindrical shape. Flower attain upto 1.5 to 2.2 cm in length and diameter ranges between 0.15 – 0.20 cm. The flowers are pale rose, pink or light violet in color with terminal, pedunculate cymes; fruits have a glabrous capsule; seed is silky [23]. The mouth of the corolla has an entire margin, with slight conspicuous depressions at the points of the cohesion of the petals, measure 5.2-6.0 cm long and 1.6-1.8 cm width at its mouth. [24] Scientifically, it known as *Ipomoea crassicaulis* and *Ipomoea fistulosa.* [25- 27]. Seed of this plant has the three sides in which two flat ventral surfaces with central depression and convex dorsal surface. [28] Taxonomical classification of genus Ipomoes is given in Table 1.

Table 1: Taxonomical classification of genus: Ipomoea [29].

Kingdom	**Plantae**
Sub kingdom	Tracheobionta
Division	Spermatophyta
Subdivision	Magnoliophyta
Class	Magnoliopsida– Dicotyledons
Subclass	Asteridae
Order	Solanales
Family	Convolvulaceae
Genus	Ipomoea
Species	carnea Jacq.

Preferred scientific name

Ipomoea carnea subsp. fistulosa (Jacq) [30]

Other scientific names

Batatas crassicaulis Benth.
Convolvulus batatilla Kunth
Ipomoea batatilla (Kunth) G. Don [31]
Ipomoea crassicaulis (Benth.) B.L. Rob. [32]
Ipomoea fistulosa Mart. ex Choisy

Some of the local names of Ipomoea used in different states of India are listed in Table 2. The names used globally are also listed in Table 3.

Table 2: Different local names in Indian continent [33].

Hindi	Beshram, Behaya
English	Bush Morning glory
Oriya	Behayo
Marathi	Beshram
Bengali	Beshram

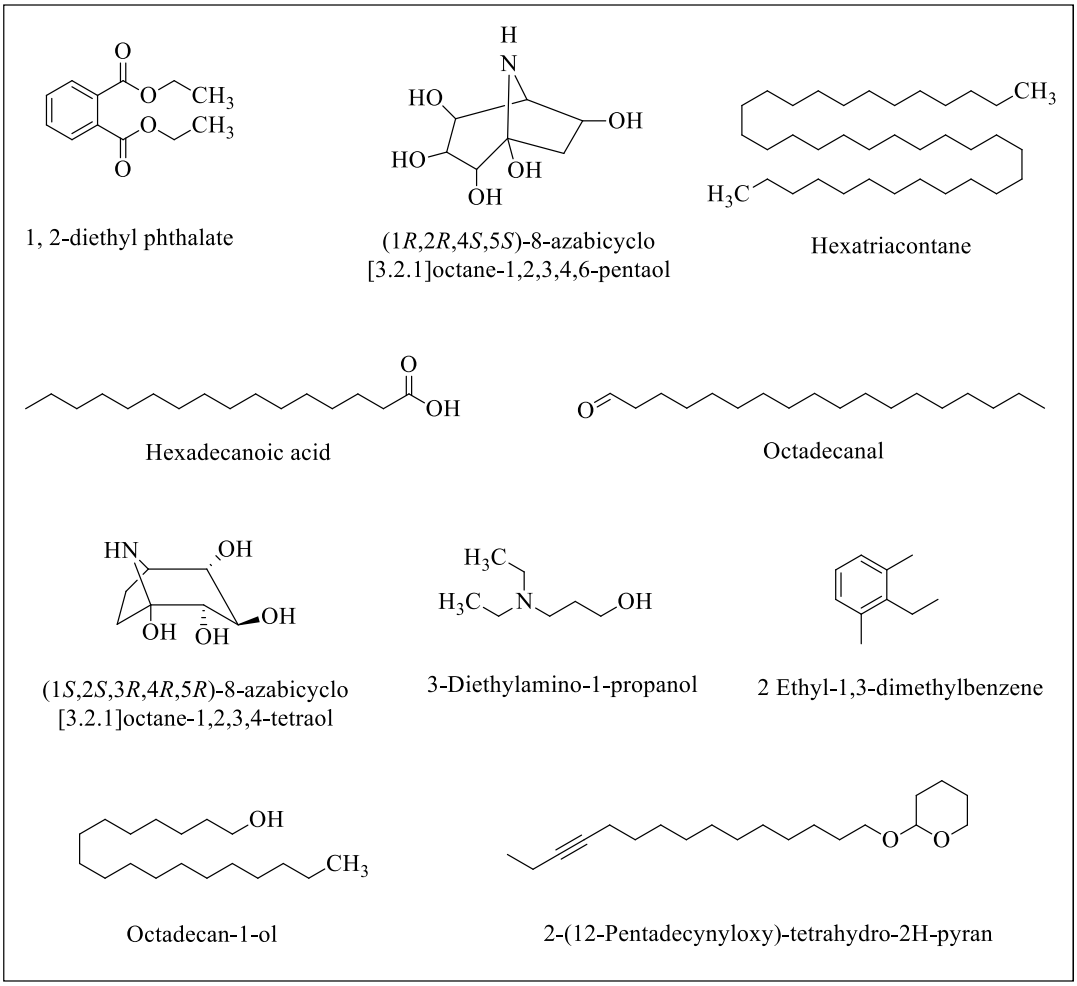
Table 3: Common names of Ipomoea used at International level

English	Bush morning-glory; tree morning glory
Spanish	Campanagallega; gloria de la manana
Chinese	Shuqianniu
Portuguese	Algodao-bravo; algodao-do-campo; campainha-de-canudo; canudo-das-lagoas; ipomeia-arborea; maniorana
Bolivia	Tararaqui
Brazil	Algodão do Pantanal; canudo; canudo de lagoa; canudo-do-breja; capabode; capa-bode; manjorana; matacabra
Cuba	aguinaldocolor de carne
Dominican Republic	Campana
Egypt	Olleiqek-kibeer
Germany	Dickstengelige; Trichterwinde
Haiti	Clochette
India	Behaya; besharam; pink morning glory; shrubby morning glory
Indonesia	Kangkungan; klemut; ula
Lesser Antilles	Ológidianochi; petite campanule
Paraguay	Mandiyura
South Africa	Morning glory bush
Thailand	Phak bung farang; phak bung rua
Zimbabwe	Morning glory-bush

The chemical constituents reported in different parts of *Ipomoea carnea* and their chemical structures are given in Table 4 and Figure 3 respectively.

Table 4: Different chemical constituents found in *Ipomoea carnea*

Root	According to Sahayaraj *et al*., 2015 roots contains 2-Ethyl-1,3-dimethylbenzene, 2-(12-Pentadecynyloxy) tetrahydro2H-pyran, 3-Furanyl[2-hydroxy-4-methyl-2- -(2-methylpropyl) cyclopentyl]- methanone, 2,2- Dideuterooctadecanal , Hexadecanoic acid and Linoleic acid. [34]
Stem	According to Sahayaraj *et al*., 2015 stem contains 2-(12-Pentadecynyloxy) tetrahydro- 2H-pyran, 1-Octadecanol, Hexadecanoic acid , Epiglobulol, Squalene, 1-Octadecanol. [34]
Leaves	According to Tirkey *et al*.,1988; Vaishali et al., 2009 presence of thirteen compounds which include hexadecanoic acid, stearic acid, 1, 2 diethyl phthalate, n-octadecanol, octacosane, hexatriacontane, tetracontane, 3- diethylamino-1- propanol. [35] According to Balogh*et al*., 1999 leaves shows presence of swainsonine and calystegines B1, B2, B3 and C1 were detected in the aqueous ethanolic extract of leaf. [36]
Flowers	According to Gupta *et al*., 2010 flowers contain flavonoids, tannins, glycosides, alkaloids, carbohydrates and phenolic compound. [37]
Seeds	According to Balogh *et al*., 1999 swainsonine and calystegines B1, B2, B3, and C1 were found to be present in seeds of *I. carnea*. [36]



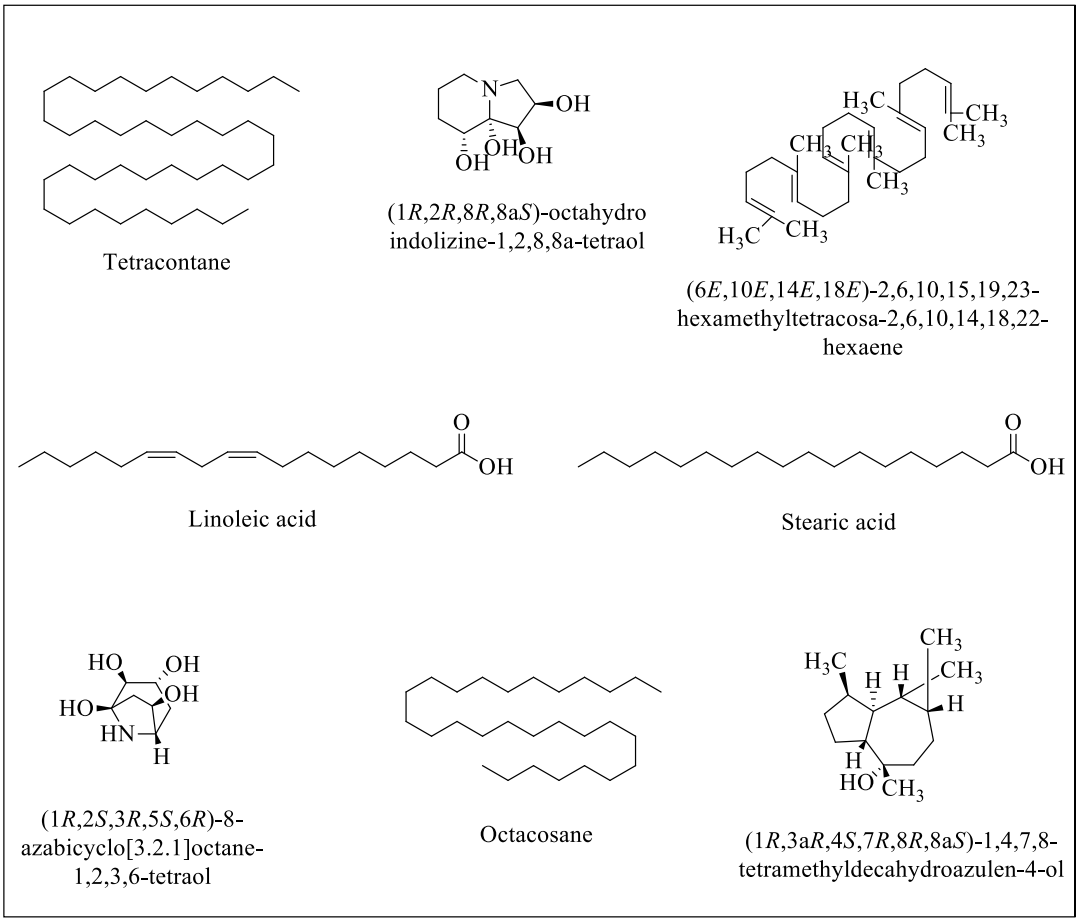


Fig 3: Chemical structures of compounds reported in *Ipomoes carnea*

Pharmacological studies

Immuno-modulatory effect

Cook *et al*., 1987; Sahayaraj and Ravi *et al*., 2008 reported that the nortropane alkaloid calystegines B_1, B_2, B_3 and C_1 and indolizidine alkaloid swainsonine of *I. carnea* shows effect of increase in spleen/body weight ratio, decrease within the thymus/body weight ratio and histological changes in female rats [37, 38].

Antioxidant activity

Abbasi *et al*., 2010; Gaur *et al*., 2009; Adsul *et al*., 2012 reported that the *I. carnea* methanolic extract was added and dissolved in water and divided in n-hexane, chloroform, alkyl group acetate and n-butanol consecutively. The inhibitory effect of these fractions were assessed by DPPH radical scavenging activity, FRAP assay, total inhibitory effect, total phenolics and metallic element salt assay were determined. The inhibitory effect by DPPH radical was highest for n-butanol fraction (91.11%} 0.68), FRAP worth was highest for alkyl group acetate fraction (511.99} 1.8 µg of trolox equivalents), total inhibitor activity was highest for chloroform (0.9096} 0.1) [39- 41].

Anti-diabetic effect

Khalid *et al*., 2011 found that the extract dose at 500mg/kg was like Glibenclamide (10 mg/kg). In human, bovine and rat β- glycosidase activities were due to competitive inhibition shown by calystegines B1 and C1. [42] Kadiyawala *et al*., 2012 reported that aqueous extract of *I.carnea* leaves showed anti-hypoglyceamic effect in streptozotocin induced diabetes in rats [43].

Anti-cancer activity

According to Kumar *et al*., 2013 it was reported that hydroalcoholic extract of *Ipomoea carnea* leaves showed dose dependent anticancer activity [44].

Sharma *et al*., 2013 reported the cytotoxic effect of hexane, chloroform and ethyl acetate fraction of *I. carnea* with the LC50 value of 141.4µg/mL, 211.28µg/mL and 307.28µg/mL, respectively. An alkaloid of *I.carnea*, named swainsonine, inhibited cell growth through induction apoptosis in human lung cancer cell line A549 [45].

Hepatoprotective activity

Gupta *et al*., 2012 reported that aqueous extract of *I. carnea* leaves revive the hepatic structural and functionality indicating markers during a dose dependent manner in carbon tetrachloride treated hepatotoxic rat model. It was found that aqueous extract of leaves reduces lipid peroxidation within the liver tissue and restores activities of anti oxidant enzymes [37].

Cardiovascular activity

According to Bachhav *et al*., 1999 the aqueous extract of *Ipomoea carnea* produced a positive inotropic effect by sodium extrusion or release of the intracellular calcium on isolated frog heart. It was observed that the initial blockage was for 5-10 seconds and can be increased upto 2 minutes by increasing the dose of extract [46].

Sedative activity

Ehattacharya & Ray *et al*., 1975 reported depressant activity of central system due to the non-alkaloidal and non saponifiable fraction isolated from the leaves of *I. carnea* on rats [47].

Rout *et al*., 2013 reported that the alcohol and aqueous extract of *I.carnea* leaves and petroleum was evaluated in mice and rats for sedative effect using phenobarbitone induced sleeping time and head dip test. It was found that sleeping time increased during a dose dependent manner and decrease in locomotive activity at high dose [48].

Anxiolytic effect

Bidkar *et al*., 2012 studied anxiolytic activity in mice using paradigm elevated plus maze, open field trial and hole based test models, diazepam was used as positive standard. The *I. carnea* leaf methanolic extract was found to be 325mg/kg i.p. weight exhibited greater anxiolytic effect as compared to *I.carnea* leaf aqueous extract and diazepam. The head dipping behaviour is increased in dose dependent manner in both methanolic and aqueous extract of *I. carnea* leaf [49].

Glycosidase inhibitory activity

Balogh *et al*., 1999 studied that using Gas chromatography – mass spectroscopy analysis of *Ipomea carnea* plant material was performed and presence of the mannosidase inhibitor swainsonine and glycoside inhibitors, calystegine B_2 and calystegine C_1, consistent with a plant –induced mannosidosis in the goats [36].

Anticonvulsant activity

Rout *et al*., 2013 suggested that the MES- induced convulsion was significantly reduced in extension phase and stupor phase by the polar extract of *I. carnea* at a dose ranging from 200mg/kg to 400mg/kg [48].

Peroxide production activity

Hueza *et al*., 2003a performed study on the serosa cells of rats and it was found that body process activity and peroxide production by macrophages increased by the administration of low dosage of *I. carnea* [50].

Wound healing activity

Ambiga *et al*., 2007 suggested that the flavanoids, kaempferol and Kaempferol-3-O-â-D-glucoside isolated from flowers of *I.carnea* possess wound healing activity in incision and excision wound model [51].

Mosquitocidal activity

Kuppusamy and Manoharan *et al*., 1992 demonstrated that extract of *I.carnea* shows synergistic effect of insecticides against malaria vector, *Anopheles stephensi* [52].

Conclusion

Various studies reported on the genus Ipomoea suggested that *Ipomea carnea* has profound potential against many diseases such as cancer, diabetes, inflammation, sleeping disorders, cardiovascular disorders etc. It contains many valuable phyto-constituents that may be used in contemporary system of medicine and may act as lead molecule in drug development process. However, pre-clinical and clinical studies are required for scientific validity and to establish its safe therapeutic use.

References

1. Frey R. *Ipomoea carnea* ssp: Fistulosa (Martius ex Choisy) Austin: taxonomy, biology and ecology reviewed and inquired. Tropical Ecology J 1995;36(1):21-48.

2. Austin DF, Huaman Z. A synopsis of *Ipomoea* (Convolvulacea) in the Americas, Taxon; 1996;45(1):3-38.
3. Shinners LH. Manual of the Vascular Plants of Texas. (Eds.: Correll, D.S., Johnston, M.C.), Renner, Texas 1970, 1241-1261.
4. Bhattacharyya PK. A note on two species of Ipomoea, namely *Ipomoea carnea Jacq.* and *Ipomoea fistulosa* Mart. Ex Choisy in eastern Asia. J Bombay Nat. Hist. Soc 1976;73:317-320.
5. Mahapata AK. A brief survey of some unrecorded, less known and threatened plant species of sundarban of West Bengal. Bull. Bot. Soc. Bengal 1978;32:54-58.
6. Sharma M. Aquatic and marshy angiosperms of Punjab. Bull. Bot. Soc. Bengal 1978;31:52-60.
7. Austin DF, Ghazanfar S. Convolvulaceae. Flora of West Pakistan. (Eds.: Nasir, E., Ali, S.I.). Agricultural Research Council, Islamabad, 1979, 1-64.
8. Dassanayake MD, Fosberg FR. A Revised Handbook to The Flora of Ceylon. Amerind Publishing Co. Pvt. Ltd., New Delhi 1980;1:508.
9. Sastri BN, Venkataraman K. Editors the Wealth of India Raw Material. New Delhi: National Institute of science communication, CSIR, 2001.
10. Farahat EA, Sewelam NA, Eid EM. Assessment of airborne trace metal pollution by *Ipomoea carnea* Jacq. leaves and its potential use as environmental indicator. The Egyptian Journal of Experimental Biology (Botany) 2012;8(1):93-98.
11. Nusrat F, Rahman MM, Asaduzzaman K, Junjiang FU. A review on *Ipomoea carnea*: pharmacology, toxicology and phytochemistry, Journal of Complementary and Integrative Medicine, 2014, 55-62.
12. Chowdhury AKA, Ali MS, Khan MOF. Antimicrobial activity of *Ipomoea fistulosa* extractives. Fitoterapia 1997;68(4):379-380.
13. Phillips O, Gentry AH, Reynal L, Wilkin P, Gulvez DCB. Quantitative ethnobotany and amazonian conservation. Conserv. Biol 1994;8(1):225-248.
14. Ved GA, Kinhal K, Ravikumar MK, Vijaya S, Indresha JH. Threat assessment and management prioritization for medicinal plants of Chattisgarh and Madhya Pradesh, FRLHT, Bangalore, India 2004, 418.
15. Guleria S, Kumar A. Antifungal activity of some Himalayan medicinal plants using direct bioautography. J Cell Mol. Biol 2006;5:95-98.
16. Ijeoma UF, Aderonke SO, Ogbonna O, Augustina MA, Ifeyinwa CN. Antinociceptive and anti-inflammatory activities of crude extracts of *Ipomoea involucrata* leave in mice and rats. Asian Pac. J Trop. Med 2011;4(2):121-124.
17. Meira M, Silva EPde, David JM, David JP. Review of the genus *Ipomoea*: traditional uses, chemistry and biological activities. Braz. J Pharmacog 2012;22:682-713.
18. Dutt D, Upadhyaya D, Malik JSRS, Tyagi CH. Studies on the pulp and papermaking characteristics of some Indian non- woody fibrous raw materials. Cellulose Chemistry & Technology 2005;39(1-2):115-128.
19. Hosomi RZ, DeSouza H, Gorniak SL, Habr SF, Penteado SW, Varoli FMF, *et al*. Embryotoxic effects of prenatal treatment with *Ipomoea carnea* aqueous fraction in rats. Braz. J Vet. Res. Anim. Sci 2008;45(1):67-75.
20. Armien AG, Tokarnia CH, Vargas PP, Frese K. Spontaneous and experimental glycoprotein storage disease of goats induced by *Ipomoea carnea* subsp *fistulosa* (Convolvulaceae). Vet. Pathol 2013;44:170-184.
21. Kiran BR, Parisara N. A review on importance of *Ipomoea carnea*. International Journal of Engineering and Modern Education (IJERME) ISSN (online): 2445-4200. 2016;1(1).
22. Sharma A, Bachheti RK. A Review on *Ipomoea carnea*. International Journal of Pharm and Bio Sciences. 2013;4(4):363-377.
23. Bhalerao SA, Teli NC. *Ipomoea carnea* Jacq: ethnobotany, phytochemistry and pharmacological potential. Int. J Curr. Res. Biosci. Plant Biol 2016;3(8):138-144.
24. Cook CDK. *Ipomoea fistulosa*: A new problem for India. Aquaphyte J 1987;7(1):12.
25. *Ipomoea carnea Jacq. Ssp. Fistulosa* (Mart. Ex Choisy) D. Austin Gloria de la manana [Home Page on the Internet]. United State Department of Agricultue SUSDA. Natural Resources conservation Service. [Cited 5 april 2016].
26. Nandkumar P. Pulp blending and its effects on the strength properties of *Ipomoea carnea Jacq.* Journal of Environmental Research and Development 2009;3(4):1088-1093.
27. Afifi MS, Amer MMA, El-Khayat SA. Macro-and micro morphology of *Ipomoea carnea Jacq*. Growing in Egypt. Part II. Stem and root. Mansoura Journal of Pharmaceutical Science 1988;4:88-97.
28. Shaltout KH, Al-Sodany YM, Eid EM. The biology of Egyptian woody perennials-2. *Ipomoea carnea* Jacq. Assiut University Buletin for Environmental Researches 2006, 75-91.
29. Shrivastava D, Shukla K. Pharmaceutical efficacy of *Ipomoea carnea*. Biol. Forum-Int. J 2015;7(1):225-235.
30. Austin DF. *Ipomoea carneafistulosa* (Mart. Ex choisy), India biodiversity.org/speies/show/263090.
31. *Ipomoea batatilla* (Kunth) G. Don: useful plants of Boyaca, Kewscience/Taxon/urn: Isid: ipui: org: names: 268478-1.
32. *Ipomoea crassicualis* (Benth) BL. Rob. [family Convolvulaceae] (stored under name) Convolvulus longifolius subsp.
33. *Ipomoea carnea Jacq. Fistulosa* (Mart. ex Choisy): Austin DF Verified by C. Nelson, 1994/08 Available on: https://www.Plants.jstor.org/stable/10.5555/al.ap.specimen.ma603827.
34. Biological control of *Ipomoea carnea* the aquatic weed [Homepage on the Internet] Agro forestry-A blog on Agrihortisilviculture. [cited 7 April 2016] [Available on: http://agrowmania.blogspot.in/2010/04/biological-controlof-ipomoea-carnea.html].
35. Sahayaraj K, Kombiah P, Dikshit AK, Rathi M. Chemical constituents of the essential oils of *Tephrosia purpurea* and *Ipomoea carnea* and their repellent activity against *Odoiporus longicollis*. J Serb. Chem. Soc 2015;80(4):465-473.
36. Tirkey K, Yadava RP, Mandal TK, Banerjee NL. The pharmacology of *Ipomoea carnea*. Ind. Vetn. J 1998;65:206-210.
37. Balogh De, Dimande KKIM, Van derLugt AP, Molyneux JJ, Naude RJ, Welman TW. Lysosomal storage disease induced by *Ipomoea carnea* in goats in Mozambique. J Vet. Diagn. In Vest 1999;11:266-273.
38. Gupta A, Nayak S, Mallik A. Preliminary phytochemical screening of hydroalcoholic flower extract of *Ipomoea*

fistulosa. Int. J. Curr. Trends Sci. Tech. 2010; 1(2):37–40.
39. Sahayaraj K, Ravi C. Preliminary phytochemistry of *Ipomea carnea* Jacq. and *Vitex negundo* Linn. leaves. Int. J. Chem. Sci. 2008; 6(1):1-6.
40. Abbasi MA, Zafar A, Riaz T, Rehman A, Arshad S, Shahwar D, *et al*. Evaluation of comparative antioxidant potential of aqueous and organic fractions of *Ipomoea carnea*. J Med. Plants Res 2010;4(18):1883-1887.
41. Gaur LB, Singh SP, Gaur SC, Saxesena RR, Parveen S, Kumar S. Facts with therapeutic significance of *Ipomoea carnea*. Punarnav 2014;2(1):141-146.
42. Adsul VB, Khatiwora E, Torane R, Deshpande NR. Antimicrobial activities of *Ipomoea carnea* leaves. J Nat. Prod. Plant Resour 2012;2(5):597-600.
43. Khalid MDS, Singh RK, Reddy IVN, Kumar SJ, Kumar BS, Kumar GNS, *et al*. Anti-inflammatory activity of aqueous extract of *Ipomoea carnea* Jacq. Pharmacol 2012. Online. 1: 326-331.
44. Kadiyawala ALA, Prasad AK, Kumar S, Iyer SV, Patel HA, Patel JA. Comparative antidiabetic studies of leaves of *Ipomoea carnea* and *Grewia asiatica* on streptozotocin induced diabetic rats. Int. J Pharmaceut. Biol. Arch 2012;3(4):853-857.
45. Kumar A, Manral U, Sharma S. Traditional remedy for muscle strain using *Ipomoea carnea Jacq.* and *Ricinus communis L.* leaves in Haryana, India. Int. J. Med. Plants 2014;108:625-631.
46. Sharma A, Bachheti RK. A review on *Ipomoea carnea*. Int. J. Pharm. Bio Sci 2013;4(4):363-377.
47. Bachhav KV, Burande MD, Rangari VD, Mehta JK. Effect of aqueous extract of *Ipomoea carnea* leaf on isolated frog and mouse heart. Ind. J Exp. Biol. 1999;37(11):1080-1084.
48. Ehattacharya SK, Ray A, Dasgupta B. Central Nervous System depressant activity of *Ipomoea carnea* Jacq. Indian J Pharmac 1975;7:31-34.
49. Rout SK, Kar DM. Sedative, anxiolytic and anticonvulsant effects of different extracts from the leaves of *Ipomoea carnea* in experimental animals. Int. J Drug Dev. Res 2013;5(2):232-243.
50. Bidkar JS, Bhujbal MD, Ghanwat DD, Dama GY. Anxiolytic activity of aqueous and methanolic extracts of *Ipomoea carnea* leaves. Int. J Universal Pharm. Bio Sci 2012;1(2):1-11.
51. Hueza IM, Fonseca ES, Paulino CA, Haraguchi M, Gorniak SL. Evaluation of immunomodulatory activity of *Ipomoea carnea* on peritoneal cells of rats. J Ethnopharmacol 2003a;87:181-186.
52. Ambiga S, Narayanan R, Gowri D, Sukumar D, Madhavan S. Evaluation of wound healing activity of flavonoids from *Ipomoea carnea* Jacq. Anc. Sci. Life 2007;26(3):45-51.
53. Kuppusamy A, Manoharan T. Synergistic effect of insecticides with plant extracts against malarial vector, *Anopheles stephensi*. Trends Life Sci 1992;7(1):39-42.