April 30, 2019

PharmacologyOnLine

Newsletter • 2019 • vol.1 • 40-48

PHYTOCHEMICAL AND PHARMACOLOGICAL REVIEW ON *BASELLA ALBA* L.

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Abstract

Medicinal plants have been traditionally used to treat various diseases since ancient period. This review aims to summarize the phytochemical, ethnopharmacological and pharmacological activities of *Basella alba* based on the published evidence in several databases (e.g., Google Scholar, PubMed, Science Direct). Findings suggest that *B. alba* has great nutritional value and is used as asperient, rubefacient and for catarrhal infections. This medicinal vegetable contains many important phytochemicals, including betacyanins, carotenoids, various organic acids, triterpene oligoglycosides, basellasapoins A, B, C and D, kaempherol, betalin, and so on. It has also been found that the plant is a good source of calcium and vitamins and various part of the plant are used as androgenic, antiulcer, antioxidant, cytotoxic, antibacterial, anti-inflammatory and anticancer agents and is used in burns and wound healing. *B. alba* is also evident to act on central nervous system as it has depressant-like effect on CNS along with the nephroprotective activity. Finally, it can be concluded that *B. alba* may be claimed as a great source of pharmacologically active compounds to develop new drug. More studies are required regarding to its safety toxicological status.

Keywords: *Basella alba, ethnomedicine, phytotherapy, biological activity*

Introduction

Medicinal plants have been used as precursors for the synthesis of various drugs (Sofowora, 1993). They are traditionally used as a natural key to treat various human ailments, because they contain various biologically active compounds such as alkaloids, flavonoids, terpenoids, sterols, tannins, glycosides, polyphenols etc. Today's pharmaceutical research has focused on natural plant product for diseases control (Anandarajagopal et al., 2011).

Basella alba L. (Family: Basellaceae) is an extremely heat tolerant, fast growing perennial vine. It is abundant in Malaysia, Philippines, South America, Topical Africa, and Brazil. It is a leafy vegetable. Nowadays, it is widely grown for its nutritive value. Almost in every area of Bangladesh and India, it is grown as a pot herb(Deshmukh et al., 2014). It is soft-stemmed vine, fast growing, reaching 10 meters (33 ft) in length, heart shaped leaves have a mild flavour and texture is mucilaginous. *B. alba* grows under full sunlight and its growth is slow in low temperature.

The useful parts of the plant are leaves, young stems, matured fruit, and roots. Dried leaves of *B. alba* (per 100 gm) contains, protein 20%, fat 3.5%, carbohydrate 54%, fibre 9%, and ash 19% and leaves contain a high level of calcium also (Adhikari et al. 2012).

In this review, we have summarized the phytochemical, ethnopharmacological and biological activities of *B. alba* based on the published evidence in Google Scholar, PubMed, Science Direct databases.

Methods

An up to date (till Jan 2019) search was done in Google Scholar, PubMed, Science Direct databases with the several keywords ("*Basella alba*", "*Basella alba* phytochemical", "*Basella alba* pharmacological" and "*Basella alba* ethnopharmacological") to select all the possible and informative evidence to be reviewed in this paper. Search yields 7265 articles. After exclusion, a total 59 articles were finally selected to perform the study.

Results

The overall findings on *B. alba* are summarized below:

Taxonomy of plant

Botanical name: *Basella alba* L.

Kingdom: Plantae
Phylum: Magnoliophyta
Class: Magnoliopsida
Order: Caryophyllales
Family: Basellaceae
Genus: Basella
Species: *B. alba*

Common names/ Vernacular names

Malabar spinach, Chinese: lu luo kui, Danish: indisk spinat, Dutch: ceylonspinazie, Filipino: Alugbati, French: baselle, German: indischer spinat, Gujarati: poi-mopal, Indonesian: gondola, Italian: spinacio della cina, Javanese: jingga, Kikuyu: murerema, Nepalese: poi sagg, Portuguese: bacela, Spanish: espinaca blanca de Malabar, Swedish: indisk, spenat, Tamil: pasali, Tamil: vaslak-kirai Telugu: baccali, Thai: phak plang, Turkish: pazu, Vietnamese: mong toi, (Eland, 2008). Bengali: puishak, Hindi: lalbachluKannada: baselesoppu, Konkani: valchibhaji, Marathi: bhajyacha vel, velbondi, mayalu; Oriya: poi saga, Sanskirt: upodika, Tamil: kodippasali, Telugu: bachhali (Adhikari et al., 2012). Different parts of the herb is shown in Figure 1.

Phytochemicals of B. alba

Basella alba contain betacyanins, carotenoids, organic acids, triterpene oligoglycosides, basellasapoins A, B, C and D. (Banerjee et al., 1992; Toshiyuki, 2001; Hebbar et al., 2004). The leaf extract contains Vitamin A, C, E, B1, B2, B3, B9, folic acid, vitaeonine and trypmin-K, protein, and fat (Yang et al., 2008), carotinoids, organic acids and water soluble polysaccharides (Khare, 2007). *B. alba* also contains minerals such as calcium, magnesium and iron. Polysaccharides with D-galactose is a major compound of Basella mucilage. *B. alba* contains basellsaponins, amino acid such as arginine, leucine, isoleucine, lysine, threonine and tryptophane (Haq et al., 1969; Khare, 2007), peptide, and phenolic compounds (Maisuthisakul and Ritthiruangdej, 2008). Kaempherol is the flavonoid present in *B. alba* at a concentration of 1.4 mg/ 100 g (Yang et al., 2008). The fruits contain gomphrenin derivatives (betalain pigment) (Glassgen et al., 1993).

Ethnopharmacology

Basella alba is often grown as an ornamental plant and very popular vegetable in Southern Nigeria. The plant has diuretic, emollient and demulcent effects. In Chinese medicine, it is claimed to reduce fever and neutralize poison. The pulped or bruised leaves are used for ulcers laxative, and are used to treat constipation in pregnant women and children. The extract mixed with *Hibiscus rosa-sinensis* is given to pregnant women as a safe aperients. The juice of the plant is used as a dye for official seals, as a rouge on the facial skin and food coloring agent. *B. alba* has a positive effect on total-body Vitamin A storage in men and the paste of root of red *B. alba* along with washed rice water is taken in the morning on an empty stomach for one month to cure irregular periods. Leaves of *B. alba* are used for the treatment of hypertension. The plant has been used for its antifungal, anticonvulsant, analgesic, anti-inflammatory and androgenic activities and for the treatment of anemia. In Ayurveda system, the herb is used to bring sound refreshing sleep when it is applied on head about half an hour before bathing. It is also used for hemorrhages, skin diseases, sexual weakness, ulcers in children and pregnant women. The paste of the root is applied to swellings and is also used as a rubefacient. The sap is applied to acne eruptions to reduce inflammation. Sugared juice of the leaves is useful for catarrhal afflictions. The leaf juice is a demulcent, and is in dysentery. The flowers are used as an antidote to poisons and diuretics. The fruits are used to prepare dark violet color for food and pasteries colorant. Basella mucilage has been used in Thai traditional medicine as a topical application for irritant, bruise, ringworm and labor. Stem and leaves are used as mild laxative, diuretic, antipyretic and burns, and has been used in Bangladesh for acne and freckle treatment widely (Saikia et al., 2006; Akhter et al., 2008). *B. alba* leaves and stem used as anticancer such as melanoma, leukemia and oral cancer. Roots and leaves have been used for stomach pains and in an increase in milk production and are used in diarrhea (Larkcom, 1991; Phillips and Rix, 1995). It is also used to treat anal prolapsed or hernia. Ground leaves of *B. alba* are rubbed with the human hand the whole preparation introduce into the animal's vagina for the treatment of sterility. The leaf juice is used in Nepal to treat dysentery and catarrh. *B. alba* has been used for the treatment of coughs, cold (leaf with stem), and cold-related infections. The mucilaginous liquid obtained from the leaves and tender stalks of plants is a popular remedy for headaches. Leaves are used in constipation, urticaria and gonorrhoea and also used in poultice local swellings, intestinal complaints, and so on (Kumar et al., 2013).

Biological effects of *B.alba*

Antioxidant activity

Reshmi et al. (2012b) evaluated the antioxidant properties of *B. alba* fruit extracts using 1,1- diphenyl 2- picrylhydroxyl (DPPH), hydroxide and superoxide, reducing power, hydrogen peroxide, metal chelating, anti-ferric chloride hydrogen peroxide system and deoxyribose degradations. Findings suggested that the plant has significant antioxidant property.

Anti-inflammatory activity

Basella leaves extracts exhibited membrane stabilization effect by inhibiting hypotonicity induced lysis of erythrocyte membrane (Chou, 1997). Kachchhava (2006) also performed an anti-inflammatory test of *B. alba* extract on carageeneen and formaldehyde induced rat models, where an aqueous extract of the herb was found to exert a significant dose-dependent anti-inflammatory effect at the dose of 500 and 100 mg/kg (p.o.).

Antiulcer activity

Venkatalakshmi and Senthamaraiselvi (2012) suggested *B. alba* –mediated anti-ulcer effect in carboxyl methyl cellulose-induced ulcer female albino Wistar rats. In this study, B. alba leaf extract was found to alter the observed ulcer parameters like ulcer index, percentage of ulcer inhibition, gastric pH, pepsin content, thiobarbituric acid reactive substances, lipid hydro peroxidases, SOD, GPx, CAT, glutathione reductase (GSH), vitamin C, and E.

B. alba against infectious diseases

B. alba plants are used locally in the treatment of infections caused by fungi, bacteria, viruses and parasites (Duke and Ayensu, 1985; Manandhar, 2002).

Hypocholesteroleromia

B. alba is used to treat hypercholesterolemia (Yokozawa et al., 2006; Yeap et al., 2015). In another study, *B. alba* extract (100 mg/kg) was found to reduce hypercholesterolemia in experimental animals (Baskaran et al., 2015).

Wound healing activity

Mohammed et al. (2012) worked on wound healing capacity of *B. alba* on male albino rats. In this study, it was observed that 20 days treatment with *B. alba* leaf extract showed a maximum wound healing capacity (Deshmukh and Gaikwad, 2014).

Androgenic activity

B. alba is evident to improve the fertility of male rats exposed in utero to flutamide, an anti-androgen drug (Nantia et al., 2012). In another study, Leydig cells purified from 70 day-old Sprague Dawley male rats and incubated with 10 and 100 µg/mL of methanolic extract of *B. alba* for 4 h, followed by the evaluation of cell viability, steroid (testosterone and estradiol) production, and the level of aromatase mRNA. The results showed that the extract did not only affect Leydig cell viability but also significantly stimulated testosterone and estradiol production, and enhanced aromatase mRNA level (Edouard et al., 2011).

Nephroprotective effect

In a study, the ethanolic extract of *B. alba* on gentamycin-induced nephrotoxic Wistar albino rats were found to exert nephroprotective effect. In this study, *B. alba* (250 and 500 mg/kg, p.o.) for 14 days and co-treated with gentamycin for 8 days, were found to reverse gentamycin-induced increased in serum and urine creatinine, urea, uric acid, gamma-glutamyl transferase (GGT), protein levels, malondialdehyde level and decreased in the concentration of total proteins and sulphydryl group (Saleh, 2011).

CNS depressant activity

In a study, Anandarajagopal et al. (2011) observed that methanol and aqueous extracts of dried aerial parts of *B. alba* (100 and 200 mg/kg, p.o.) exerted CNS depressant activity in experimental animals.

Cytotoxic and antibacterial activity

The methanolic extract of the herb (*B. alba*) showed the significant growth inhibition on human cancer cell lines and momentous zone of inhibition for microorganisms studied (Rathee et al., 2010).

Hemopoesis effect

Oral administration of the aqueous extract of *B. alba* in rats for two weeks caused gradual and significant increases in the mean RBC count, mean PCV, and increase in the other haematological parameters (WBC, Hb Conc. and platelet) in the experimental animals (Bamidele et al., 2010).

Miscellaneous

B. alba has been used for the treatment of anemia, hemorrhoids, sexual weakness, constipation, ulcers and as a diuretic, laxative, anti-cancer such as melanoma, leukemia. Its use has also been discovered as anticonvulsant, rubefacient, asperient, demulcent, anti-inflammatory, androgenic, antipyretic and for catarrhal afflictions (Shruti et al., 2012). Besides these *B. alba* also showed anti-melanoma, anti-leukemia (Shruti et al., 2012). *B. alba* is used to treat sexual asthenia and infertility in males (Moundipa, 1999), atherosclerosis, ischemic heart disease, aging, diabetes mellitus, immunosuppression, neuro-degenerative diseases (Young and Woodside, 2001; Mathur et al., 2008; Pham-Huy et al., 2008), constipation, urticaria and gonorrhoea (Ghani, 1998), used as a rubefacient and used in poultice localswellings, intestinal complaints (Manandhar, 2002), poisoning (Duke and Ayensu, 1985), fungal infection (Hugo et al., 2005), lipidperoxidation (Olaniyi, 2013), liver toxicity (Dasa et al., 2014), obesity (*B. alba* at 100 and 200 mg/kg, p.o., for 4 weeks (Baskaran, 2015), and headaches (Jadhav et al., 2011). Moreover, *B. alba* leaf mucilage and chitosan as matrix format can be used to Controlled Release Cefixime Nanoparticles (Harika, 2016) and as a binder in paracetamol tablets prepared by the wet granulation method (Ramu et al., 2011).

Discussion

The vegetable and medicinal herb, *B. alba* and its many parts are widely used in the world for its medicinal value. It is used for haemorrhages, skin diseases, sexual weakness, burn wounds, ulcers and

as laxative in children and pregnant women, and so on (Haneefa, 2012). *B. alba* is evident to possess antioxidant (Reshmi et al., 2012b), anti-inflammatory (Kachchhava, 2006), membrane stabilizing (Chou, 1997) activity in scientific reports.

The curative property of *B. alba* is remarkable in the case of gastric ulcer, wounds and infectious diseases. It seems, *B. alba* and its derivatives can be used in cosmetics and preparation of medicines for skin diseases (Chatchawal and Nualkaew, 2010). Multiple biological effects of *B. alba* reported earlier, such as improvement of male virility and fertility, could therefore be partly attributed to its antioxidant activity (Edouard, 2013). Reshmi et al. (2012) and Venkatalakshmi and Senthamaraiselvi (2012) demonstrated that *B. alba* has strong activity against *Lactobacillus* sp. and *Aspergillus fumigates*. Moreover, *B. alba* is also found to act against a number of cancer cells (Rathee et al., 2010) and it contains the known antioxidant vitamins A, C, E, and K (Bamidele, 2010). The substances having antioxidant and cytotoxic property are good for the development of anticancer therapeutics (Islam et al., 2016).

Furthermore, the vitamins and minerals present in *B. alba* are well-known hematinics and are necessary for the formation of blood cells (Sushila et al, 2010). Therefore, B. alba maybe one of the model medicinal herbs having therapeutic benefits with harmless pharmacological effects (Deshmukh and Gaikwad, 2014).

In summary, this review suggests that *B. alba* has valuable nutrients such as Vitamins, proteins, carbohydrates, fats and minerals. According to the ethnopharmacological reports, *B. alba* and its extracts or preparations are used to treat various diseases in many countries. Scientific reports also suggesting that *B. alba* possesses many important phytochemicals and pharmacological activities. Among the biological effects, androgenic, antidiabetic, anti-inflammatory, antimicrobial, antioxidant, antiulcer, mantiviral, CNS depressant, hepatoprotective and wound healing properties are remarkable. *B. alba* may be one of the best sources of phytomedicines.

Acknowledgments

We are are owed to the DEMSTED and Faculty of Pharmacy, Ton Duc Thang University, Ho Chi Minh City, 700000, Viet Nam.

References

1. Aase S (1989) Disturbances in the balance between aggressive and protective factors in the gastric and duodenal mucosa. Scand J Gastroenterol 24:17.
2. Akhter S, Abdul H, Shawkat IS, Swapan KS, Mohammad SHC, Sanjay SS (2008) A review on the use of non-timber forest products in beauty-care in Bangladesh. J Forestry Res 19:72-78.
3. Anandarajagopal K, Sudhahar D, Ajaykumar TV, Muthukumaran G (2011) Evaluation of CNS Depressant Activity of Aerial Parts of *Basella alba* Linn. IJPI'S J Pharmacol Toxicol 1:5.
4. Deshmukh SA, Gaikwad DK (2014) A review of the taxonomy, ethnobotany, phytochemistry and pharmacology of *Basella alba* (Basellaceae). Semantic Scholar 2014. Link:https://www.semanticscholar.org/paper/A-review-of-the-taxonomy-%2C-ethnobotany-%2C-and-of-(-)-Deshmukh-Gaikwad/a404bf4a30eb8abf83b0365ab4dac0b5b5cfce77.
5. Adhikari R, Kumar N, Shruthi SD (2012) A review on medicinal importance of *Basella alba* L. Int J Pharm Sci Drug Res 4:110-114.
6. Bamidele O, Akinnuga AM, Olorunfemi JO, Odetola OA, Oparaji CK, Ezeigbo N (2010) Effects of aqueous extract of *Basella alba* leaves on haematological and biochemical parameters in albino rats. Afric J Biotechnol 9:6952-6955.
7. Harika B, Shanmuganathan S. Gowthamarajan K (2016) Formulation and Evaluation of Controlled Release Cefixime Nanoparticles Prepared using *Basella alba* Leaf Mucilage and Chitosan as Matrix Formers. B. Harika et al /J Pharm Sci Res 8:92-99.
8. Chou CT (1997) The anti-inflammatory effect of *Tripterygium wilfordii* Hook F on adjuvant-induced paw edema in rats and

inflammatory mediators release. Phytother Res 11:152-154.
9. Crawford JW (2000) The gastrointestinal tract. In: Robbins pathologic Basis of Disease. Cotran, R.S., Kumar, V., Collins, T. (Eds), 6th Edn, Saunders, Noida, India; pp. 793-796.
10. Chatchawal C, Nualkaew N, Preeprame S, Porasuphatana S, Priprame A (2010) Physical and Biological Properties of Mucilage from Basella alba L. Stem and Its Gel Formulation. IJPS 6:104-112.
11. Duke JA, Ayensu ES (1985) Medicinal Plants of China. Medicinal Plants of the World. Reference Publications Inc, Algonac, MI 1:362. Link: http://apps.who.int/medicinedocs/en/d/Js716oe/.
12. Deshpande S, Shah GB, Deshpande I, Parmar NS (2003) Antiulcer activity of aqueous extract of *Basella rubra* in albino rats. J Nat Remed 3/2:212-214.
13. Eland S (2008) Plant Biographies. Link: www.plantlives.com/docs/B/Basella_alba.pdf.
14. Edouard AN, Carine T, Faustin-Pascal TM, Serge C, Thomas KM, Paul FM (2011) Effects of the Methanol Extract of *Basella alba* L (Basellaceae) on Steroid Production in Leydig Cells. Int J Mol Sci 12:376-384.
15. Nantia EA, Manfo FPT, Beboy NSE, Moundipa PF (2013) In vitro antioxidant activity of the methanol extract of *Basella alba* L (Basellaceae) in rat testicular homogenate. Oxid Antioxid Med Sci 2:131-136.
16. Glassgen WE (1993) Betacyanins from fruits of *Basella rubra*. Phytochemistry 33:1525-1527.
17. Glassgen WE, Metzger JW, Heuer S, Strack D (1993) Betacyanins from fruits of *Basella rubra*. Phytochemistry 33:1525-1527.
18. Ghani A (1998) Medicinal Plants of Bangladesh. Asiatic Society of Bangladesh, Dhaka, p-97, 104, 126, 141, 201, 230.
19. Ramu G, Krishna Mohan G, Jayaveera KN (2011) Preliminary investigation of patchaippasali. mucilage (*Basella alba*) as tablet binder. Int J Green Pharm 5:24.
20. Baskaran G, Salvamani S, Azlan A, Ahmad SA, Yeap SK, Shukor MY (2015) Hypocholesterolemic and Antiatherosclerotic Potential of *Basella alba* Leaf Extract in Hypercholesterolemia-Induced Rabbits. Evid-Based Compl Alter Med. Doi: 10.1155/2015/751714.
21. Haq QN, Awal A, Chowdhury MK, Khan NA (1969) Water-soluble polysaccharides from the leaves of *Basella rubra*. Sci Res 6:63-66.
22. Hebbar SS, Harsha VH, Shripathi V, Hegde GR (2004) Ethnomedicine of Dharwad district in Karnataka, India--plants used in oral health care. J Ethnopharmacol 94:261-266.
23. de Boer HJ, Kool A, Broberg A, Mziray WR, Hedberg I, Levenfors JJ (2005) Anti-fungal and anti-bacterial activity of some herbal remedies from Tanzania. J Ethnopharmacol 96:461-469.
24. Islam MT, Streck L, Alencar MVOB, Silva SWC, Machado KC, Machado KC, Júnior ALG, Paz MFCJ, Mata AMOF, Sousa JMC, Junior JSC, Rolim HML, Silva-Junior AA, Melo-Cavalcante AAC (2017) Evaluation of toxic, cytotoxic and genotoxic effects of phytol and its nanoemulsion. Chemosphere 177:93-101.
25. Jadhav VD, Mahadkar SD, Valvi SR (2011) Documentation and ethnobotanical survey of wild edible plants from Kolhapur District. Recent Res Sci Technol 3:58-63.
26. Kachchhava AB (2006) Studies on anticonvulsant, analgesic and anti-inflammatory activities of leaf extracts of *Basella alba*. Dissertation work Submitted to the Rajiv Gandhi University of Health Sciences, Bangalore. Link: https://www.academia.edu/7490667/Basella_review_pdf.
27. Khare CP (2007) Indian medicinal plants: An illustrated dictionary. Springer- Verlag Berlin/Heidenberg, p. 83.
28. Larkcom J (1991) Oriental Vegetables the complete guide for kitchen and vegetables. John Murray, London, p. 232.
29. Murugasan N, Vember S, Damodharan C (1981) Studies on erythrocyte membrane IV. In vitro haemolytic activity of Oleander extract. Toxicol Lett 8:33-38.

30. Moundipa FP, Kamtchouing P, Koueta N, Tantchou J, Foyang NP, Mbiapo FT. 1999; Effects of aqueous extracts of Hibiscus macranthus and Basella alba in mature rat testis function. J Ethnopharmacol 65:133-139.
31. Manandhar NP (2002) Plants and People of Nepal. Timber Press, Oregon. J Ethnobiol 23:313-314. Link: https://ethnobiology.org/sites/default/files/pdfs/JoE/23-2/Sacherer2003.pdf.
32. Maisuthisakul P, Ritthiruangdej PS (2008) Relationship between antioxidant properties and chemical composition of some Thai plants. J Food Compos Anal 21:229-240.
33. Mathur PP, Saradha B, Vaithinathan S (2008) Impact of environmental toxicants on testicular function. Immun Endocr Metab Agents Med Chem 8:79-90.
34. Manandhar NP (2002) Plants and People of Nepal Timber Press. Oregon. ISBN 0-88192-527-6.
35. Haneefa MKP, Abraham A, Saraswathi R, Mohanta GP, Nayar C (2012) Formulation and Evaluation of Herbal Gel of *Basella alba* for wound healing activity. J Pharm Sci Res 4:1642-1648.
36. Nirmala A, Saroja S, Vasanthi HR, Lalitha G (2009) Hypoglycemic effect of *Basella rubra* in streptozotocin induced diabetic albino rats. J Pharmacogn Phytother 1:25-30.
37. Nirmala A, Saroja S, Gayathri Devi G (2011) Antidiabetic activity of *Basella rubra* and its relationship: with the antioxidant property. British Biotechnol J 1:1-9.
38. Nantia EA, Manfo PF, Beboy NE, Travert C, Carreau S, Monsees TK, Moundipa PF. 2012; Effect of methanol extract of *Basella alba* L. (Basellaceae) on the fecundity and testosterone level in male rats exposed to flutamide in utero. Andrologia 44:38-45.
39. Olaniyi T, Adedosu, Adekunle AS, Adedeji AL, Afolabi OK, Oyedeji TA (2013) Antioxidant and anti-lipidperoxidation potentials of the ethylacetate and chloroform extracts of *Basella alba* leaves. 2:2.
40. Phillips R, Rix M (1995) Vegetables Macmillan Reference Books: London.
41. Pham-Huy AL, He H , Pham-Huy C (2008) Free radicals, antioxidants in disease and health. Int J Biomed Sci 4:89-96.
42. Venkatalakshmi P, Senthamaraiselvi V (2012) Anti-ulcer effect of *Basella alba* leaf extract in aspirin induced albino rats. Int J Pharm Sci Res 23:2539-2542.
43. Rathee S, Ahuja D, Rathee P, Thanki M, Rathee D (2010) Cytotoxic and Antibacterial Activity of Basella alba Whole Plant: A Relatively Unexplored Plant. Pharmacologyonline 3:651-658.
44. Sushila R, Deepti A, Permender R, Madhavi T, Dharmender R (2010) Cytotoxic and Antibacterial Activity of *Basella alba* Whole Plant:A Relatively Unexplored Plant. Pharmacologyonline 3:651-658.
45. Adhikari R, Kumar NHN, Shruthi SD (2012) A Review on Medicinal Importance of *Basella alba* L. Int J Pharm Sci Drug Res 4:110-114.
46. Reshmi SK, Aravindhan KM, P Suganya Devi (2012b) Antioxidant analysis of betacyanin extracted from Basella alba fruit. Int J Pharm Tech Res 4:900-913.
47. Sofowora A (1993) Medicinal Plants and traditional medicines in Africa. 2nd Ed. Karthala Ibadan Nigeria. Link: http://www.sciepub.com/reference/41679
48. Saikia AP, Ryakala VK, Sharma P, Goswami P, Bora U (2006) Ethnobotany of medicinal plants used by Assamese people for various skin ailments and cosmetics. J Ethnopharmacol 106:149-157.
49. Saleh A (2011) Protective effect of *Basella alba* L. on nephrotoxicity induced by gentamycin in rats. Clin Exp Med J 5:225-233.
50. Adhikari R, Kumar NHN, Shruthi SD (2012) A review on medicinal importance of *Basella alba*. International J Pharm Sci Drug Res 4:110-114
51. Reshmi SK, Aravinthan KM, Devi PS (2012) Antimicrobial activity of *Basella alba* fruit. Int J Phar Sci Res 24: 4757-4761
52. Kumar S, Prasad AK, Iyer SV, Vaidya SK (2013) Systematic pharmacognostical, phytochemical and pharmacological review on an ethno medicinal plant, *Basella alba* L. J Pharmacogn Phytother 5:53-58.

53. Das S, Bandyopadhyay S, Ramasamy A, Mondal S (2015) Evaluation of hepatoprotective activity of aqueous extracts of leaves of *Basella alba* in albino rats. Nat Prod Res 29:1059-1064.
54. Deshmukh SA, Gaikwad DK (2014) A review of the taxonomy, ethnobotany, phytochemistry and pharmacology of *Basella alba* (Basellaceae). J Appl Pharm Sci 4: 153-165.
55. Yeap SK, Beh BK, Ho WY, Mohd Yusof H, Mohamad NE, Ali NM, Jaganath IB, Alitheen NB, Koh SP, Long K (2015) In vivo antioxidant and hypolipidemic effects of fermented mung bean on hypercholesterolemic mice. Evid Based Complement Alternat Med 2015:508029. doi: 10.1155/2015/508029.
56. Toshiyuki M (2001) Medicinal Foodstuffs. XXIII Structures of New Oleanane-Type Triterpene Oligoglycosides, Basellasaponins A, B, C, and D, from the Fresh Aerial Parts of *Basella rubra* L. Chem Pharm Bull 49:776-779.
57. Yokozawa T, Cho EJ, Sasaki S, Satoh A, Okamoto T, Sei Y (2006) The protective role of Chinese prescription Kangen-karyu extract on diet-induced hypercholesterolemia in rats. Biol Pharm Bull 29:760-765.
58. Young IS, Woodside JV (2001) Antioxidants in health and disease. J Clin Pathol 54:176-186.
59. Yang RY, Lin S, Kuo G (2008) Content and distribution of flavonoids among 91 edible plant species. Asia Pac J Clin Nutr 17:275-279.
60. Yang RY, Lin S, Kuo G (2008) Content and distribution of flavonoids among 91 edible plant species. Asia Pac J Clin Nutr 17:275-279.
61. Kumar V, Bhat ZA, Kumar D, Bohra P, Sheela S (2011) In-vitro anti-inflammatory activity of leaf extracts of *Basella alba* Linn. Int J Drug Develop Res 3:176-179.
62. Venkatalakshmi P, Senthamaraiselvi V (2012) Anti ulcer effect of Basella alba leaf extract in Aspirin induced Albino rats. Int J Pharm Sci Res 3:2539-2542.

Figure 1. Morphology of *Basella alba* plant (A), along with fruits (B), buds (C), adaxial (D) and abaxial (E) surfaces of the leaf