

An overview study on chemical constituents and biological activities of *vitex peduncularis* wall

Abstract

Vitex Peduncularis is commonly known as 'goda' in Bangladesh and belongs to Verbenaceae family. An overview is conducted the species considering some of the essential aspects, chemical constituents and biological activities like antipyretic activity, antioxidant activity, antimicrobial, antifungal and anti-inflammatory activity. As many of research results, Flavonoids, terpenoids, triterpenoids and iridoids are the main phytochemical constituents of *Vitex Peduncularis* Wall.

Keywords: antioxidant activity, antipyretic activity, chloroform, chemical constituents, *vitex peduncularis*

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Introduction

Vitex Peduncularis is a moderate sized tree found in Bangladesh, India and many other countries.¹ The plants are known to produce certain bioactive molecules which react with other organisms in the environment and in turn cause the inhibition of bacterial or fungal growth. Medicinal plants that have been traditionally used to produce a variety of compounds with known therapeutic properties.^{2,3} These kinds of plants are used as antipyretic.⁴ The bark is used for the external application of the chest pain.⁵ The plants of this genus have an overabundance of ethanopharmacological usage for treating a range of human ailments related to insects, bacteria, fungi, snakes and poisonous spiders and diseases associated with gynecological problems.

Traditionally, the boiled bark extract of *Vitex peduncularis* is used as a drink to treat the joint ache. According to Suksamran and Bheemsankarrao, leaves of *Vitex peduncularis* contain the compounds like peduncularaside, iridoid, anguside, vitexin, triterpenoids and flavonoids which act as anti-inflammatory properties.^{6,7} It is also known to promote the cardiovascular health by improving blood and nutrient flow of the heart muscles. Although this plant is used as a traditional system of medicine for a long period of time, they have some lack of the scientific documentation, particularly in the light of modern scientific knowledge.⁸ The demand for more and more drugs from this kind of plants sources are continuously increasing. Therefore, it is essential for a systematic evaluation of these plants for using in the traditional medicine in various ailments.

Discussion

Description of the plant

A medium-sized to large deciduous tree, 6-12m high, leaves 3-foliolate, rarely 4, petiole up to 10cm long; leaflets lanceolate or narrow elliptic, 5-15cm long, entire, long acuminate, base cuneate.

Flowers are yellowish, in axillary many-flowered, paniced cymes, 15-20cm long, long-peduncled. Fruit a drupe, globular, size of a black pepper, black when ripe.⁹

Vernacular names

This plant has the different names in the different region to different countries like in Bengali: Boruna, Goda, Horina (Chittagong, Bangladesh), Awal (Sylhet, Bangladesh), Hindi: Charaiygoda and in Chinese: Chang Xu Jing.

Tribal names

The name of this plant is also varying tribal to tribal. For example, Krawru (Mogh), Ashmul gaas (Chakma), Salong, Kra-ro-ba, Chakhua, Korobaong (Marma), Ashhoi, Shilangri (Garo) (Figure 1) (Table 1).⁹

Table 1 Taxonomical Classification

| Taxonomical classification | |
|----------------------------|-------------------------|
| Kingdom | Plantae |
| Phylum | Magnoliophyta |
| Class | Magnoliotae |
| Order | Lamiales |
| Family | Verbenaceae |
| Genus | Vitex |
| Species | Vitex peduncularis Wall |



Figure 1 The Plants of *Vitex Peduncularis* Wall.

Phytochemical constituents

A review of the literature reveals that the presence of various chemical constituents in the different parts of the *Vitex peduncularis* are flavones, 4'-acetoxy-5-hydroxy-6, 7-dimethoxyflavone together with four known compounds, crisimartin, genkwainin, 3 α -friedelinol and 3 β -friedelinol have been isolated from the leaves of *Vitex peduncularis*.¹⁰ A new iridoid, pedunculariside, together with the known agnuside were isolated from the butanol extract of *Vitex peduncularis* stem bark.⁶ Earlier studies on different parts of the plant reported the isolation of flavonoids-vitexin, pachypodol, peduncularism, ursolic acid and 2 α -hydroxyursolic (Figure 2).¹⁰

Pharmacological activity

In pharmacology, the biological activity or pharmacological activity describes the beneficial or adverse effects of a drug on living matter. If a drug is a complex chemical mixture, this activity is exerted by the substance's active ingredient and each gradient can be modified chemically. The herbal medicine has played a great role in preventing and treating several diseases including infectious diseases in Bangladesh. Leaves and barks of the *Vitex peduncularis* are used for diabetes in the hill area of Khagrachari district, Bangladesh. Extraction of the dried leaves yielded pachypodol, ursolic acid, 2 α -hydroxyursolic acid, vitexin and peduncularisin. In Orissa, a decoction of the leaves is taken as drinking tea during the cold season. An infusion of leaves administered intramuscularly or orally to rabbits increases the osmotic resistance of cells and inhibits the haemolysis production by saponin, cobra venom, bile salts, or saline solution.¹¹ The paste prepared from the bark is taken for jaundice by the Chakma people. The extract prepared from root mixed with hot water and taken two or three tea spoons daily twice until cured. The extract is also applied externally in the affected area for the treatment of abnormality in eyes and face like paralysis. A bark extract is taken with water for the treatment of urethritis by the Marma people.⁶

Antipyretic activity

Vitex peduncularis has been used over the past centuries as traditional medicine for treatment of malarial and black fevers. Black Fever is called Kalazor in Bangladesh which is known as visceral leishmaniasis is caused by protozoan parasites of leishmania species. A preliminary screening of the methanolic leaf extracts of *V. peduncularis* and *Vitex pinnata* showed significant antileishmanial activity against leishmania donovani.¹² Here is also showed a little antipyretic activity by some of the compounds although not found very good result for any specific compounds.

Antioxidant activity

An antioxidant is a molecule that inhibits the oxidation of other

molecules. In biological systems, the antioxidants are defined as "the substance that is present at low concentrations compared to those of an oxidizable substrate and which significantly delays or prevents oxidation of that substrate." This covers all oxidizable substrates i.e., some lipids, flavonoids, terpenoids, and iridoids.¹³ Antioxidants are widely used in dietary supplements and have been investigated for the prevention of diseases such as cancer, coronary heart disease, stroke, Alzheimer's disease, Rheumatoid arthritis, cataracts and even altitude sickness.¹⁴ Antioxidants also have many industrial uses, such as preservatives in food and cosmetics and to prevent the degradation of rubber and gasoline.¹⁵ Here the flavonoids, terpenoids and iridoid are the antioxidant compounds. The phenol derivatives also showed little antioxidant activity.

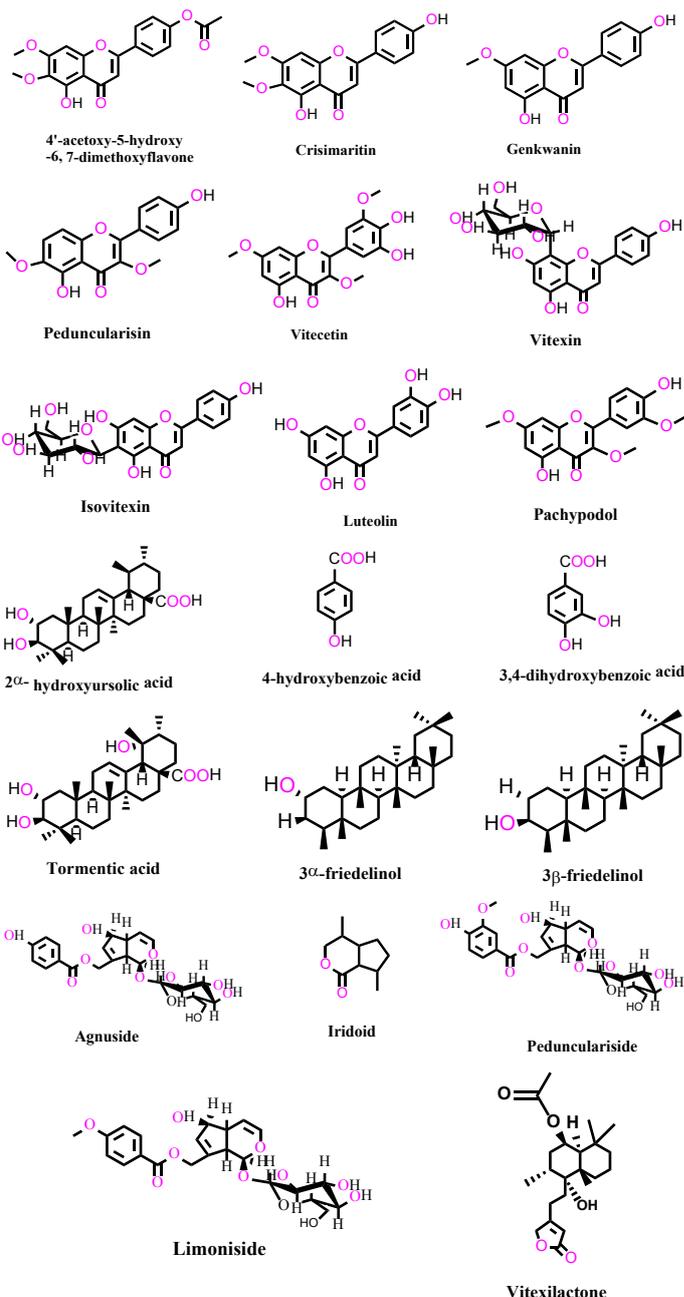


Figure 2 The Chemical constituents of *Vitex Peduncularis* Wall.

Anti-inflammatory activity

Iridoid, pedunculariside and iridoid agnaside were isolated from the stem bark of *V. peduncularis* with butanol extraction. They showed inhibition of COX-2 with IC₅₀ value of 0.15±0.21mg/ml and 0.026±0.015mg/ml respectively, only small inhibitory effects on COX-1.¹⁶ 20 Polyphenols were identified and quantified for the first time, including C-rhamnosyl flavones infrequently reported.⁶ Regarding of the potential anti-inflammatory properties, the methanolic extract of the stem bark significantly reduced the levels of NO in macrophages, which may be a consequence of scavenging effect upon •NO. Significant inhibition of phospholipase A₂ activity was also noted. Consequently, the therapeutic applicability of this edible plant is also broadened due to the anti-inflammatory properties found.¹⁷

Antibacterial activity

Different organic solvents like methanol, chloroform were used with the leaf and stem extract from *Vitex peduncularis* were screened for antibacterial activity against bacterial pathogens like *Salmonella typhi*, *Salmonella typhimurium*, *Shigella flexineri*, *Shigella boydic*, *Pseudomonas sp.*, *Enterococcus sp.*, *Enterobacter aerogens*, *Escherichia coli*, *Chromobacterium violaceum*, *Staphylococcus aureus*, *Proteus mirabilis*, *Klebsiella sp.*, and six fungal pathogens such as *Aspergillus niger*, *Aspergillus fumigatus*, *Aspergillus flavus*, *Candida sp.*, *Rhizopus sp.*, and *Sclerotium sp.* Methanolic extracts from both leaf and stem from the observation showed maximum inhibitory against all the test pathogens which are known to be associated with Urinary Tract infections. Maximum antibacterial activity was found in methanolic extract against *S. aureus* (34.1mm). According to Panda et al.¹⁸ preliminary screening of the extracts was carried out by disc diffusion method. Freshly grown liquid culture of the test pathogens were seeded over the nutrient agar plates with a sterile swab. Sterile filter paper discs were soaked with different concentration of extracts of individual solvents and were placed on the plates at equidistance. Then the plates were incubated at 37°C for 18-24hrs. Clear zone was formed around the discs indicates a positive antimicrobial activity and were measured. Each experiment was carried out in triplicates. The mean±SD of the inhibition zone was taken for evaluating the antibacterial activity of the extracts.^{18,19}

Antifungal activity

Leaf and stem extracts from of *Vitex peduncularis* also showed the antifungal activity according to Panda et al.¹⁸ by using different organic solvents against different pathogens. Maximum antifungal activity was observed against *Candida sp.* and *Rhizopus sp.* and showed a clear inhibition zone of 26.2 and 30.1mm, respectively. Antifungal activity was evaluated against five human pathogenic fungi as shown in Figure 3. The response shown by pathogenic fungi was very clear and distinct. The *Candida* and *Rhizopus* species being most sensitive showed the clear inhibition zone of 26.2 and 30.1mm, respectively in both methanol and chloroform extract. Similarly, from Figure 3 it can be concluded that the methanolic extract of stem showed maximum activity against *Aspergillus flavus* compared to other fungal strains and in case of chloroform extract, the antifungal activity was maximum in *Rhizopus sp.* and *Sclerotium sp.* which constitutes about 22%. No antifungal activity was observed in case of aqueous extract of both leaf and stem.²⁰

Cytotoxic activity

Epifriedelinol was isolated from the leaves of *Vitex peduncularis*

(Verbenaceae) and reported to possess the strong antibacterial, anti-inflammatory and antioxidant property. Moreover, this herb was traditionally used for the management of cancer. Two cancer cell lines C-33A and HeLa of cervical cancer were selected and affected of epifriedelinol on the process of apoptosis induction. Literature suggested that several anticancer drugs induces apoptosis process and thereby alters the growth of cancer cells. In the reported investigation there was increasing property in the oligonucleosomes production that characterizes the induction of apoptosis. In addition, treatment with epifriedelinol significantly translocates cytochrome c and also enhances the activity of caspase enzymes. Bcl-2 regulates the intrinsic pathway of apoptosis and apoptosis process was regulated by the ratio of proapoptotic to anti-apoptotic proteins. In this study, the treatment with epifriedelinol significantly down regulates the expressions of anti-apoptotic protein and enhances the expressions of pro apoptotic protein. Literature also suggested that cell proliferation in cancer results due to suppression of protein also and IAP protein inhibits the apoptosis. Moreover, this protein enhances the resistance of cancer cell for the apoptosis.²¹ In the recent year molecules are targeted to this protein by the scientist for the design of new strategies to treat the cancer. The results of our study showed that an expression of IAP protein significantly declines after the treatment with epifriedelinol.²²

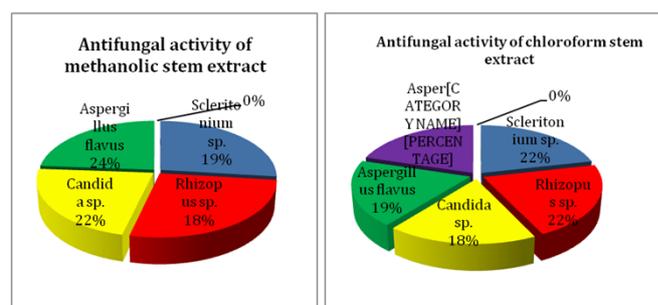


Figure 3 Antifungal activity of stem extract (methanol and chloroform) of *Vitex peduncularis*.

The major techniques for the extractions, isolations, purifications, identifications and characterizations

In brief, the major technique for the extractions, isolations, purifications, identification and characterizations of the compounds had been described in publications. Generally, the plant samples were separated & dried at room temperature followed grinded into powder. The dried powder was extracted with different solvents. The solvent extract was dissolved in water and partitioned with organic solvents e.g., n-hexane, dichloromethane, ethyl acetate and 1-butanol. Separations of different extracts were done by repetitive column chromatography. Isolation and purification of the compounds from the different fractions were carried out, using different chromatographic methods including HPLC. Determination of the structure of the isolated compounds were done by different spectroscopic methods like UV, IR, ¹H-NMR, ¹³C-NMR, DEPT-90, 135, COSY, HMBC, HSQC, and Mass spectroscopy.

Conclusion

The *Vitex peduncularis* wall has been treating various diseases and it has a great number of pharmaceutical usages specially the antibacterial and antifungal active results of these kinds of compounds showed good to excellent. Unexpurgated repository references have been provided in the text to assist the comprehensive overview on

Vitex peduncularis with an objective to update researchers with proper information for its effective research for human health.

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Conflict of interest

The author declares no conflict of interest.

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