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PHYTOCHEMISTRY AND PHARMACOLOGICAL IMPORTANCE OF *POLYGONUM VISCOSUM*: A REVIEW

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ABSTRACT: *Polygonum viscosum*, belonging to the family Polygonaceae, is an annual herb which is highly distributed in Bangladesh, China, Nepal, Japan, and India. Like any other plant of the genus *Polygonum*, *P. viscosum* is significant from both phytochemical and pharmacological properties. Findings regarding the use of this plant in pain, fever, tumor, infection, inflammation, blood clots and so forth mark it as a valuable and noteworthy plant. According to our knowledge, there are very few studies presently available that document all the biological activities of *P. viscosum*. Hence, the following review gives a critical assessment of the literature to date and is the first review on the mentioned plant combining the limited research data found on *Polygonum viscosum*.

INTRODUCTION: Plants have been used as the traditional source of raw materials for medicines since the beginning of civilization of mankind. According to the World Health Organization, over 80% of the world's population (about 4.3 billion people) is reliant on traditional plant-based systems of medicine for their primary health care. In this regard, it is found that plants and their products possess several pharmacological activities including analgesic, anticancer, anti-diabetic, immunomodulation, nervous system activation, antipyretic, hepato- protection, etc.¹ A large number of plants of medicinal importance have been explored by the scientists and researchers for the treatment of various ailments².

Most of the medicinal plants have specific compounds which are effective in the treatment or prevention of diseases. Regarding this medicinal plants have also been a reliable source for preparation of new drugs. In the present era, researchers are more dependent on medicinal plants for the discovery of new drugs with fewer side effects³. Numerous species of genus *Polygonum* are utilized in traditional medicine therapy and reported to contain various pharmacological properties.

Furthermore, a potential medicinal plant under the family Polygonaceae is *Polygonum viscosum*. It is also known as "Sobuj Bishkatali" in Bengali and found widely in Nepal, China, Bangladesh, Japan and northeast part of India⁴. Parts of this plant is known to be traditionally used for the treatment of diseases as such fever, inflammation, tumors, pain, infections, cancer and so on⁵. Conferring to the knowledge up to this day, there are very limited studies available at the moment about the biological activities of *P. viscosum*⁶.

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The present study is an attempt to compile an up-to-date and comprehensive review of the plant *Polygonum viscosum* that mainly concentrates on its phytochemistry and pharmacological uses.

Synonyms: *Persicaria kuekenthalii* H. Lév., *Persicaria viscosa* (Buch.-Ham. ex D. Don) H. Gross ex Nakai, *Polygonum kuekenthalii* H. Lév., *Polygonum viscosum* var. minus Hook. F.

Vernacular Names: Bengali: Sobuj Bishkatali; Chinese: Xiang liao.

Taxonomical Classification:

Kingdom: Plantae
 Phylum: Angiospermae
 Class: Dicotyledoneae
 Order: Polygonales
 Family: Polygonaceae
 Genus: Polygonum
 Species: *Polygonum viscosum*

Botanical Description: *Polygonum viscosum* is an annual herb. Its stems are erect or ascending, 50-90 cm tall, much branched, densely hirsute and glandular hairy. The petiole is short or nearly absent; leaf blade ovate-lanceolate or elliptical-lanceolate, 5-15 × 2-4 cm, both surface hispid, densely so along veins, margin entire, densely shortly ciliate. It has long, ochrea ciliate, tubular, 1-1.2 cm, membranous.



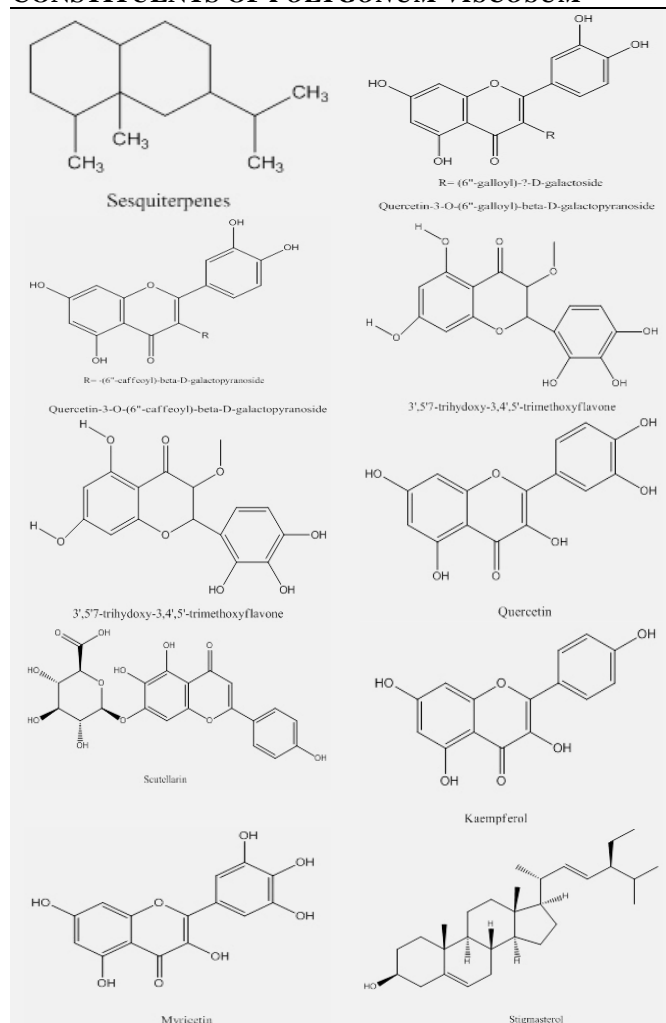
FIG. 1: *POLYGONUM VISCOSUM*

Polygonum viscosum has inflorescence terminal or axillary, spicate, 2-4 cm; peduncle densely hirsute and glandular hairy; bracts funnel-shaped. The perianth is pinkish, 5-parted; tepals, elliptic, 3 mm. Stamens 8, included. Styles 3, connate to below middle. This plants nuts included in persistent perianth, black-brown, shiny, trigonous, 2.5 mm. *Polygonum viscosum* is widely distributed in

Northeast India, Bangladesh, and Japan. It is indigenous to Nepal. It occurs in various habitats; found in the mountains, along roadside, riversides and paddy fields⁷.

Chemical Constituents: *Polygonum viscosum* has been reported to have many chemical constituents isolated from them.

TABLE 1: STRUCTURES OF SOME CHEMICAL CONSTITUENTS OF *POLYGONUM VISCOSUM*^{8-12, 13, 14}



It includes sesquiterpenes, viscoazucine, viscoazusone, viscozulenol, viscoazulone, viscozulenol methyl ester, viscosomic acid and polygomic acid and flavonoids, viscoazucinic acid, 3', 5'-dihydroxy-3, 4', 5', 7-tetramethoxyflavone, quercetin-3-O-(6''-feruloyl)-β-D-galactopyranoside, quercetin-3-O-(6''-galloyl)-β-D-galactopyranoside and 3', 5', 7-trihydroxy-3, 4', 5'-trimethoxyflavone, quercetin-3-O-(6''-caffeoyl)-β-D-galactopyranoside⁸⁻¹². Quercetin-3-O-(6''-galloyl)-β-D-galactoside from *Polygonum viscosum* (Polygonaceae)¹³.

Moreover, phytochemical evaluation of chloroform extract of roots of *P. viscosum* has yielded six compounds which were isolated for the first time from *Polygonum viscosum*. These compounds are stigmaterol, 7, 4 dimethyl quercetin, kaempferol, quercetin, myricetin, and scutellarin. The characterization of these compounds is done by spectroscopic methods and chemical analysis¹⁴.

Pharmacological Properties:

Anticholinergic Activity: Datta and his colleagues found that isolated compound quercetin 3-O-(6-feruloyl)- β -D- from the aerial parts of *Polygonum viscosum* indicated mild anti-cholinergic activity. This study was used to investigate the effect of test compounds on stomach muscle by taking acetylcholine as the spasmogen from guinea pigs the tissues were isolated, prepared accordingly the method described by Blattner *et al.*, (1978). The tissue strips had been allowed to stabilize for 30 min before any compounds were added. On a UGO Basile model GEMINI 7070 2-channel polygraph contractions and relaxations were measured isometrically and displayed by Using force displacement transducer (UGO Basile, Italy). Spasmogen was applied to the tissue at 8 min intervals until constant responses were obtained⁹.

Anti-oxidant Activity: *P. viscosum* has moderate antioxidant activity. Moghal *et al.*, (2014) found this plant as a good source of total phenolic contents because of crude methanolic, pet. ether, carbon tetra chloride, and chloroform extract showed total phenolic contents of 12.35 μ g of GAE/mg, 11.4 μ g of GAE/mg, 19.83 μ g of GAE/mg and 21.55 μ g of GAE/mg extracts respectively. Polyphenolic compounds such as tannins and flavonoids are present in this plant that yield antioxidant property. It was also found that antioxidant activities of different extracts of the leaves of *P. viscosum* increase with increasing concentrations⁶.

Anthelmintic Activity: Majumder *et al.*, (2014) found in a study that the extracts of *Polygonum viscosum* leaves possess significant anthelmintic activity in dose-dependent manner and the activity of the crude extract was equivalent with that of standard drugs. For this purpose, earthworms were tested with methanolic extracts of leaves of the plant followed by the determination of the paralysis

and death of worms. On a note, adult earthworms were used to study the anthelmintic activity because they resemble with the intestinal roundworm parasites of a human being anatomically and physiologically and because of their easy availability².

Anti-HIV Activity: Extracts of *P. viscosum* have anti-HIV effect. By using the reverse transcriptase assay the NCI Cancer Research and Development Center, Frederick, Maryland, USA evaluated the *in-vitro* anti-HIV-1 activity inhibitory activity against recombinant HIV-1 reverse transcriptase were tested by viscoazulone and quercetin, which was prepared and assayed following the method described by Kashman *et al.*, (1992) with certain modifications. Buffer contained 50 mM tris, pH 7.8, 0.15 mg/mL dithiothreitol (DTT) and 0.1% triton X-100, virus disruption buffer (VDB) test compounds were diluted. Serial dilutions of compounds were added in the individual well of a 96-well V-bottom plate.

In VDB recombinant enzyme was diluted and added to appropriate wells (50 mL/well). Only VDB received by RT control wells. Aliquotes of 10 ml from each well were added to 30 ml of cocktail containing 2 ml of 1 mM tris, pH 7.8, 1 ml of 3 MKCL, 5 ml of 3 mg/mL DTI, 5 ml of 0.1 M magnesium acetate, 10 ml of poly (rA)-p(dT)50(2 units/mL), 6.5 ml of distilled water, 0.5 ml of 10% triton X-100 and 10 ml of [3H] dTTP (16.56 Ci/mmol). Onto DE81 ion-exchange paper samples were harvested, incubated for 30 min at 37 degree Celsius and absorbed with distilled water. Pads were counted in a liquid scintillation counter after drying⁵. Viscoazulone and quercetin exhibited significant anti-HIV-1 activity with IC₅₀ values of 33.13 and 25.61 mg/mL, respectively⁹.

Analgesic Activity: Researchers reported analgesic activity of 4 sesquiterpenes, viscosumic acid, viscozulenolic acid, viscoazucine and viscoazulone, and a flavonoid glycoside, quercetin-3-O -(6"-feruloyl)- beta -D -galactopyranoside isolated from the aerial parts of *P. viscosum* (Polygonaceae). Pain relieving action of the isolated compounds was contemplated as a proportion of pain perception time in response to thermal stimuli. All isolated compounds, aside from viscoazulone, indicated measurably significant (P<0.01) pain relieving

action in contrast with that of the positive control morphine. Among these compounds, viscozulenol methyl ester was found to have moderate pain relieving action, while viscosomic acid, viscoazucine, and quercetin 3-O-(6-feruloyl)- β -D-galactopyranoside indicated mild pain relieving movement¹⁴.

Thrombolytic Activity: Thrombosis is a physical process of developing thrombus or blood clots in the human circulatory system. It can lead to heart attack, strokes, and other coronary conditions. As a result, anticoagulation therapy and thrombolytic agents or drugs are essential for the management of thrombosis patients. Apart from commonly used drugs for this purpose, some medicinal plants such as *P. viscosum* have been found to have significant thrombolytic properties by Moghal et al., 2014. A study showed that after treatments of a blood clot with 100 microliters of crude methanolic extract, petroleum ether extract of *P. viscosum* in the concentration of 20, 10, 5 mg/mL showed varying clot lysis, i.e., 12.49, 9.54, 6.69% and 17.07, 13.81, 7.92% respectively. This concluded that the extracts of this plant have significant thrombolytic activity compared to negative control. The thrombolytic activity can be an outcome of the fact that the extracts are good sources of alkaloids, tannins, flavonoids, and terpenoids which are believed to exert clot lysis⁶.

CNS Depressant Activity: Datta and his colleagues found that viscoazucine and viscoazulone (Isolated from *Polygonum viscosum*) exhibited significant CNS depressant activity which was evident from a gradual decrease in movement of the treated mice. The decrease in movement with time after administration of the other test compounds i.e. viscosomic acid, viscozulenol methyl ester and a flavonoid glycoside, quercetin-3-O-(6-feruloyl)- β -D-galactopyranoside indicated moderate CNS depressant activity of viscosomic acid and quercetin-3-O-(6-feruloyl)- β -D-galactopyranoside, and mild activity of viscozulenol methyl ester at a dose of 50 mg/kg body weight¹⁴.

Anti-bacterial Effect: Three new sesquiterpenes viscozulenol methyl ester, viscoazucinic acid, and polygosomic acid have been isolated from the chloroform extract of the aerial parts of *Polygonum viscosum* by reversed-phase preparative HPLC.

Among these compounds, polygosomic acid is the most active and displayed antibacterial activity against different bacteria like *Bacillus cereus*, *Citrobacter freundii*, *Escherichia coli*, penicillin-resistant *Escherichia coli*, *Klebsiella aerogenes*, *Pseudomonas aeruginosa*, *Staphylococcus aureus*.

The most noteworthy activity of polygosomic acid was against methicillin-resistant *S. aureus*, and the most potent activities were found against penicillin-resistant *E. coli* and *S. aureus*. Both viscozulenol methyl ester and viscoazucinic acid inhibit the growth of *Bacillus cereus*, *Klebsiella aerogenes*, *Lactobacillus plantarum*, *Pseudomonas aeruginosa* and *Staphylococcus aureus* due to their structural similarity⁸.

Anti-inflammatory Activity: *P. viscosum* extracts possessed moderate anti-inflammatory activity on raw paw edema induced by carrageenan. Anti-inflammatory activity on a moderate scale was observed. The extracts of *Polygonum viscosum* showed this activity on raw paw edema induced by carrageenan. Viscosomic acid, viscozulenol methyl ester, viscoazucine, and viscoazulone, and a flavonoid glycoside, quercetin-3-O-(6-feruloyl)- β -D-galactopyranoside isolated from the aerial parts of this plant were tested for this activity.

Among them, viscozulenol methyl ester showed mild to moderate anti-inflammatory activity, viscosomic acid and viscoazulone showed mild anti-inflammatory activity. However, viscoazucine and quercetin-3-O-(6-feruloyl)- β -D-galactopyranoside did not exhibit any significant effect on carrageenan-induced paw inflammation⁹.

Cytotoxic Activity: The flavonoid glycoside from the aerial parts of the *Polygonum viscosum* exhibited cytotoxic activity against ovarian cancer cell line (OVCAR-3) while *in-vitro* cytotoxic assays were performed⁹.

Anti-tumor Activity: Ethyl acetate fraction of *Polygonum viscosum* leaves exhibited remarkable antitumor activity. *Polygonum viscosum* showed a significant decrease in tumor volume, packed cell volume and viable cell count and increased the life span of Ehrlich ascites carcinoma bearing mice¹⁶.

CONCLUSION: This review illustrates a detailed description of *Polygonum viscosum* and its

significance. This is one of the traditional medicinal plants on which numerous researches had been conducted. We can be benefitted from this plant to a great extent as it possesses important pharmacological activities.

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CONFLICT OF INTEREST: Authors declare no conflict of interest.

AUTHOR'S CONTRIBUTION: The review was conducted under the supervision of Pritesh Ranjan Dash (PRD) who also designed the study. The introduction was done by a collaboration of Safiqa Hossain (SH) and Anika Mahmood (AM). Serially, synonyms were retrieved by Zeba Raisa (ZR) along with AM, vernacular names and taxonomical classification were searched and collected from the internet by AM.

The botanical description was written by SH while the figures of the plant were founded by Nasib Bin Mahub (NBM). Next, the chemical constituents were explored by ZR while the structures for them were done by NBM with the use of ChemDraw.

In the next part, which is medicinal properties of *Polygonum viscosum*, AM contributed in the anti-oxidant, anthelmintic and thrombolytic activity; NBM contributed in the anti-tumor and anti-bacterial activities; SH contributed in the anticholinergic, anti-HIV activity, analgesic, and CNS depressant activity and ZR contributed in the anti-inflammatory activity and cytotoxic activity. All authors read and approved the final manuscript.

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