Pharmacology of *Bergenia pacumbis*

Subjects: Agricultural Engineering

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Bergenia pacumbis (Buch.-Ham. ex D.Don) C.Y.Wu & J.T.Pan (synonym: *Bergenia ligulate* Engl.), is an important medicinal plant belonging to the Saxifragaceae family, and not to be confused with *Bergenia ciliata* (Haw.) Sternb., and is popularly known as Pashanbheda (meaning to dissolve the kidney stone).

Bergenia ligulata | antibacterial activity | diuretic activity

1. Pharmacology

Owing to the occurrence of a diverse range of phytochemicals, *B. pacumbis* shows numerous pharmacological activities. Till date, a diverse array of pharmacological activities such as anti-inflammatory, antibacterial, anti-viral, diuretic, antilithic, anti-bradykinin, hepatoprotective, antipyretic, α-glucosidase activity, free radical scavenging, analgesic, anti-oxaluria, anti-tumour, and cardioprotective activities have been reported from various parts of *B. pacumbis* [1][2][3][4][5][6] (**Figure 1**).

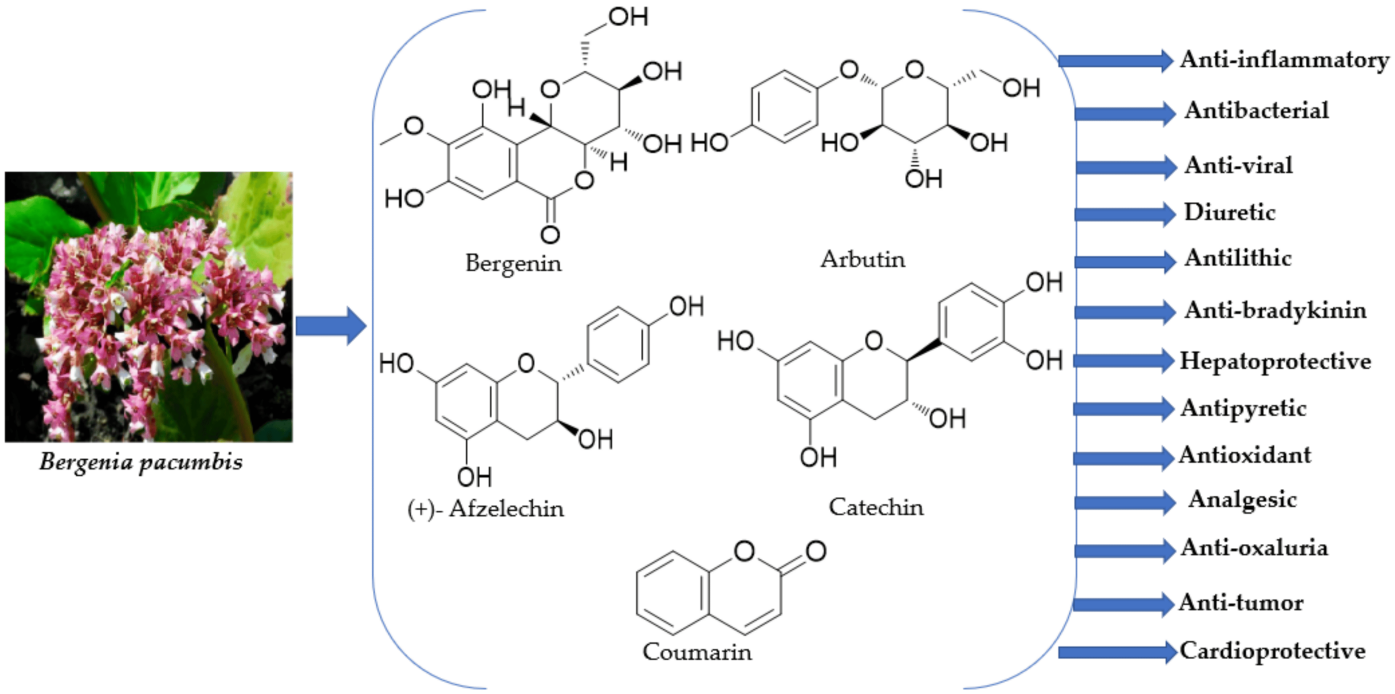

Figure 1. Critical pharmacological applications of *Bergenia pacumbis* (Buch.-Ham. ex D.Don) C.Y.Wu & J.T.Pan.

2. Anti-Inflammatory

Studies have exposed that aqueous and alcoholic extracts of fresh rhizomes of *B. pacumbis* show anti-inflammatory activity in biological systems at a dose level of 1 gm/kg. [7]. An amount of 0.1 mL of 1% carrageenan solution was injected into the left-hand paw of the rat and caused an increase in the volume of the rat's paw. This volume increment is measured every hour, and then the inhibition percentile is calculated. Results show that *B. pacumbis* has an excellent potential for anti-inflammatory activity [7][8]. Research has also revealed that *B. pacumbis* possesses some radical scavenging activity [9].

3. Antibacterial

The literature revealed that *B. pacumbis* extracts also possess antibacterial activity [1][4][7][10]. The plant extract was used in three concentrations (10, 25, 50 mg/mL), and the antibacterial activity was measured via the disc diffusion method. The various extracts of the plant (methanolic, ethanolic, and aqueous) was tested in a culture plate containing *Escherichia coli, Bacillus subtilis,* and *Staphylococcus aureus* at the dosages mentioned above and the extracts contain significant antibacterial activities. Reports show that at a concentration of 50 mg/mL, the antibacterial activity reached maximum levels, which were found to be equal to the antibacterial activity of ciprofloxacin (25 mg/mL) [7].

4. Anti-Viral

Anti-viral activities of *B. pacumbis* have been reported in a study on Nepalese medicinal plants [11][12]. The extracts (methanolic and hydromethanolic) were analyzed for influenza and herpes viruses, and the highest anti-influenza viral activity was observed at the dosage of 10 µg/mL [13]. The rhizome of *B. pacumbis* was used to prepare an extract containing methanol and water as a solvent, and this extract had good viral inhibitory properties against the influenza virus [4][13]. The extract inhibits the viral RNA synthesis, and the study shows that the peptide synthesis rate was decreased strongly at the concentration of 10 µg/mL. The study revealed that tannin is the main component present in the plant rhizome extract, increasing protein availability and acting as an antioxidant and as a metal ion chelator in the chosen biological systems [5].

5. Diuretic Activity

The ethanolic extracts of *B. pacumbis* roots were tested on albino rats to study their diuretic activity using the Lipschit method [14][15]. Diuretic activity was suspected by measuring the volume of urine collected at an interval of 5 h and also by measuring the Na^+, K^+, and Cl^- ion concentrations in urine collected from the rats [16]. The ethanol extracts possess the highest diuretic activity. The same group of researchers also studied the effects of an ethanolic extract of *B. pacumbis* roots on artificial urine and human urine where CaC_2O_4 crystals were introduced in the first one. In the case of human urine, the crystals were already present. On adding extract prepared from the roots of *B. pacumbis*, artificial urine showed the reduction of the crystal ring size, which confirms that the extract

may be active in-vitro. Nevertheless, when the extract was applied to the human urine, it showed remarkably other characteristics than CaC_2O_4 crystal inhibition such as antioxidant effects and hypermagneseuric effects. From these results, it was concluded that *B. pacumbis* possesses diuretic activity [7][15][16].

Further studies revealed that methanolic extracts of *B. pacumbis* and bergenin showed a noticeable dissolution of urinary calculi in the kidney. In-vitro antilithiatic/anti calcification potential of different extracts obtained from *B. pacumbis* and *Dolichos biflorus* L. were tested independently and in combination by the homogeneous precipitation method [17]. The results of tested extracts were compared against 'Cystone' (a Himalaya company formulation sold in India) aqueous extract. *Bergenia pacumbis* extract showed lesser activity while *D. biflorus* extract displayed almost equivalent activity as compared to 'Cystone'. Although, the combination of two extracts is less active in comparison to the individual extracts. The author concluded that active constituent/s may act by inhibiting calcium and phosphate accumulation and are non-protein and non-tannin in nature. Another study on rats revealed that, the low doses of *B. pacumbis* alcoholic extracts (0.5 mg/kg) promote diuresis, but higher doses (100 mg/kg) retard the diuresis produced by urea and urine output. It is also reported that, the aqueous extracts of *B. pacumbis* have better potential as compared to the aqueous extract of *Tribulus terrestris* L. for inhibiting the growth of calcium oxalate monohydrate crystals [18]. This research showed that there are secondary metabolites present in *B. pacumbis* known to play a significant role in the dissolution of calcium oxalate monohydrate crystals [17].

6. Antilithic

The antilithic property of an alcoholic extract of *B. pacumbis* showed no effect in rats in the inhibition of stone formation, but the low dosage of crude alcoholic extract (0.5 mg/kg of extract) endorses the diuresis, and higher dosage (100 mg/kg of extract) reduced the diuresis produced by urea [19][20]. The study also revealed that applying 0.75% ethylene glycol in water (5–10 mg/kg extract) of *B. pacumbis* rhizome in rats prevents the deposition of the crystal in the renal tubules of a rat. The application of *B. pacumbis* rhizome extract prevented the side effects after lithogenic treatment such as polyuria, decreased antioxidant, weight loss, renal dysfunction, etc. The study also showed that after extract application, there was a slight increase in the Mg^{2+} ions in the urine, indicating the anti-urolithic activity of *B. pacumbis* [19][21][22][23][24].

7. Anti-Bradykinin Activity

Though the rhizome extract of *B. pacumbis* shows anti-bradykinin potential, it does not affect the activity of acetylcholine and 5-hydroxytryptamine (5-HT) on guinea-pig ileum. The rhizome extract increases the adrenaline level on the guinea pig trachea, and in addition, the smooth ileum muscle shows cardiotoxicity and central nervous system depressant activity. In rats, the lethal dosage of the aqueous extract of *B. pacumbis* rhizome was 650 mg/kg (i.p.). It is widely used to treat painful or difficult urination, renal failure, infection, or inflammation of the urinary bladder and crystalluria, which is caused due to the side effects of sulfonamides and penicillin, abscesses, cutaneous infection, dysentery, and diarrhoea [1][25][26].

8. Hepatoprotective

The hepatoprotective activity was investigated in albino rats (weight 25–35 gm) by using the ethanolic extract of *B. pacumbis* roots and compared with the standard drug "Liv-52" (manufactured by Himalaya Drug Company, Bangalore), by inducing hepatotoxicity using carbon tetrachloride (CCl_4). The investigation was performed using the Up and Down or Staircase method [16]. The ethanolic extract of *B. pacumbis* restored the integrity of hepatocytes indicated by improvement in physiological parameters, which was confirmed by measuring the levels of transaminase, serum alkaline phosphatase, oxaloacetate, serum glutamate, pyruvate transaminase, serum glutamate, and bilirubin levels and known to have a significant hepatoprotective potential [1][14].

9. Antipyretic

The literature revealed that *B. pacumbis* possess a substantial antipyretic potential. Singh and coworker examined the ethanol (95%) and aqueous extract obtained from the roots of *B. pacumbis* for their antipyretic potential. The extracts were mixed with 2% gum acacia and injected to Wistar rats (500 and 300 mg/kg body weight) infected with pyrexia [16]. Paracetamol (200 mg/kg, standard antipyretic) was used as a positive control. The rectal temperature of the infected rats was noted after an interval of 1 h. A noteworthy lowering in the rat's body temperature was noted with ethanol extract (500 mg/kg) (**Figure 2**). The present study along with others reports validated that *B. pacumbis* owns substantial antipyretic activity [14][16][27].

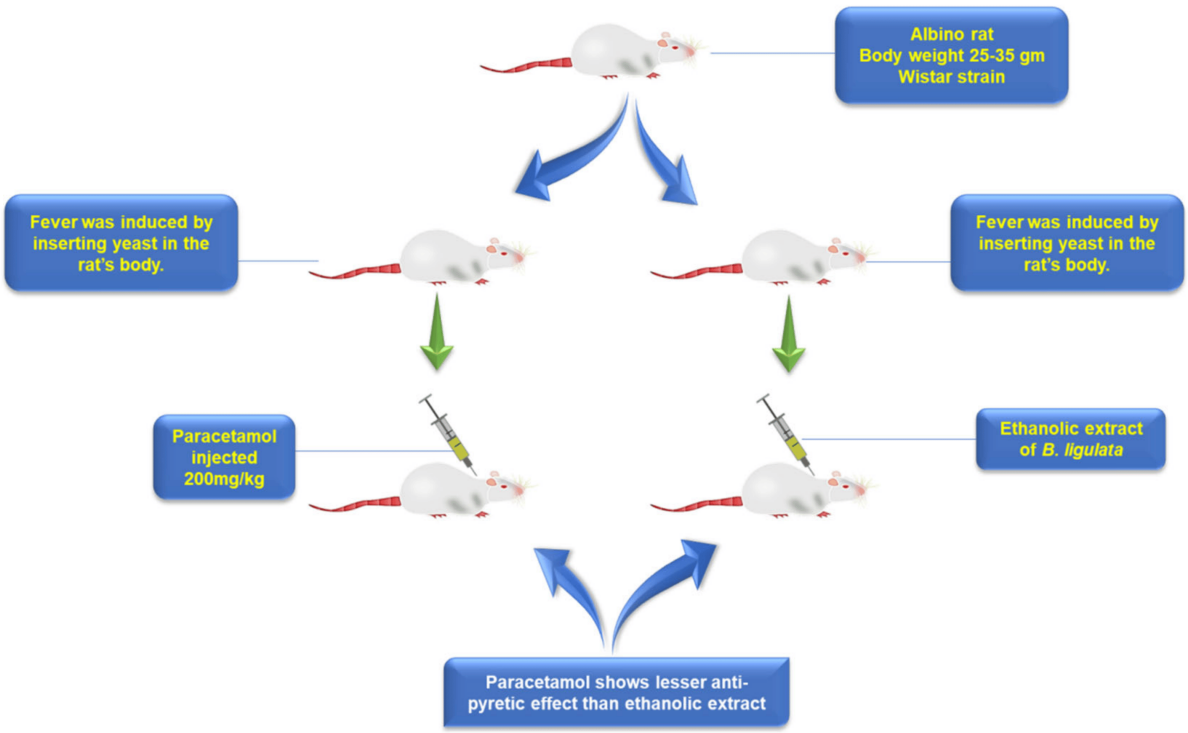

Figure 2. Antipyretic activity of *Bergenia pacumbis* (Buch.-Ham. ex D.Don) C.Y.Wu & J.T.Pan.

10. α-Glucosidase Inhibition Activity

The ethanolic extract (80%) of *B. pacumbis* rhizome led to the investigation of α-glucosidase activity at dose levels of 5.0, 0.5, and 0.05 mg/mL and the ethyl acetate extract was used to inhibit the effect of α-glucosidase activity. The trigger compound was identified as (+)-afzelechin (2 g), which was confirmed by EI-MS, IR, proton NMR, and ^{13}C NMR spectral analysis [22]. Further, the inhibitory activity of the compound at a concentration of 0.25 mM was studied at a 50% inhibition dose, i.e., 0.13 mm. ID_{50} values of (+)-catechin and (-)-epicatechin were 12.8 mM and 0.18 mM, respectively. From these data, the α-glucosidase inhibitor in *B. pacumbis* is primarily due to the presence of (+)-afzelechin [22][28][29].

11. Antioxidant Activity

Bergenia pacumbis methanolic extract efficiently scavenge 1, 1-diphenyl-2-picrylhydrazyl (DPPH) free radicals and exhibit good free radical scavenging potential with an IC_{50} value of 50 µg/mL. The water and n-butanol fractions obtained from methanol extract were screened for their free radical scavenging potential (in-vitro) by DPPH and the nitric oxide assay. The n-butanol and water fractions showed the IC_{50} value of 4.5 µg/mL and 30 µg/mL, respectively [30][31]. Bergenin isolated from *B. pacumbis* also showed significant antioxidant potential [32][33].

12. Analgesic

The analgesic potential of *B. pacumbis* rhizomes was assessed by employing hot plate and tail clip methods using hydroalcoholic extract (250 mg/kg), which was administered intra-gastrically in the mouse. However, the extract exhibited much less analgesic potential during the study [1][5][14].

13. Anti-Oxaluria

Anti-oxaluria activity on Indian adults was studied where tablets were prepared with *Didymocarpus pedicellatus* R.Br., *B. pacumbis, Rubia cordifolia* L., *Cyperus scariosus* R.Br., *Achyranthes aspera* L., *Veronica cinerea* Boiss. & Balansa, Hajrul yahood bhasma, and Shilajeet purified in the ratio 65:49:16:16:16:16:16:13 (in mg) and investigated on 32 healthy volunteers and 48 people suffering from stones. All patients were given two tablets (3 times/day) and advised to avoid oxalate-rich foods in their diet, and the treatment lasted for 8 weeks. A steady decrease in oxalate elimination was noted in persons infected with kidney stones, but the level of oxalate elimination was not as low as observed in usual adults. This research revealed that the present formulation might deliver a capable drug that regulate the activity of oxaluria [1][34].

14. Anti-Tumor

Bergenia pacumbis hydroalcoholic extract was injected intraperitoneally in rats to evaluate its anti-tumour potential. The extract exhibited activity against SARCOMA WM1256 IM cell culture at the dose of 20 mcg/mL, which pointed out that *B. pacumbis* hydroalcoholic extract exhibited cytotoxic activity [1].

15. Cardioprotective

The hypotensive activity of *B. pacumbis* hydroalcoholic extract was carried out in different animal models. A positive hypotensive activity was noted in dogs when injected with 50 mg/kg dose (i.v.) [1]. Further, the *B. pacumbis* extract also showed positive inotropic and chronotropic effects on a frog's heart [25]. While in the case of continuous rabbit's heart perfusions, the extracts exhibited adverse chronotropic and inotropic effects with a decrease in coronary flow. The alcoholic extract *B. pacumbis* elicited marked anti-bradykinin activity (in-vitro and in-vivo) but was unable to modify the response of acetylcholine and 5-HT on guinea-pig isolated ileum [1][35].

16. Insecticidal Activity

Kashima and coworkers evaluated the insecticidal potential of essential oil and parasorbic acid obtained from roots of *B. pacumbis* against adults of *Drosophila melanogaster*. The results revealed that both the essential oil and parasorbic acid were active against the insect, but parasorbic acid had more insecticidal potential as compared to the essential oil [28].

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