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Research Article

Anti-inflammatory activity of root bark and stem bark of Patala *(Stereospermum suaveolens* DC.)

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Abstract

Background: *Ayurveda,* traditionally known as 'The Science of Life' represents one of the world's oldest comprehensive medical systems. In the modern era, the increasing global demand of *Ayurvedic* medicines has led to a critical shortage of specific raw materials, frequently resulting in adulteration that may prove hazardous to public health. Consequently, there is an urgent need to establish "Abhava Pratinidhi Dravya" (Official substitutes) to ensure the continued efficacy and safety of traditional formulations while promoting environmental conservation. Aim: The primary objective of this research was to scientifically evaluate the pharmacological utility of the Stem bark of *Stereospermum suaveolens* DC. (*Patala)* as a viable substitute for its Root bark, which is the official part currently sanctioned by the Ayurvedic Pharmacopoeia of India (API). Materials and Methods: The Study focused on evaluating the comparative anti-inflammatory activity of *Kwatha* (aqueous decoction) prepared from the standardized samples of both stem bark and root bark. The experimental protocol utilized the carrageenan-induced hind paw oedema model to assess the pharmacological response in vivo. Results: The Effect of % increase in paw volume in Control group experienced 90.16 ± 1.77. The group treated with Root bark *Kwatha* demonstrate significant inhibitory effect with an increase of only 62.37 ± 6.73*, while Stem bark *Kwatha* group showed a measurement of 82.85 ± 5.62. Conclusion: An apparent decrease in paw oedema was observed in both treatment groups compared to the control. While the Root bark exhibited superior potency, the stem bark demonstrated measurable anti-inflammatory activity, supporting its potential role as a sustainable alternative. However, this inference should be studied by clinical evaluation.

Keywords: Anti-inflammatory activity, Stem bark, Root bark, *Patala, Dashmoola, Stereospermum suaveolens*

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Introduction

Dashmoola is designated to cure wide range of disorders occurring due to vitiated *Vata*, *Pitta* and *Kapha* doshas (1). *Dashmoola* is obtained from roots of 5 tree species, 2 shrub species and 3 herb species. *Dashmoola* compound formulation is composed of combination of 10 roots obtained from *Bilva* - *Aegle marmelos* (L.) Corrêa (Tree), *Agnimantha* - *Premna serratifolia* L. (Tree), *Shyonaka* - *Oroxylum indicum* (L.) Kurz. (Tree), *Patala* - *Stereospermum chelonoides* (L.f.) DC. (Tree), *Gambhari*-*Gmelina arborea* Roxb. ex Sm. (Tree), *Shalparni* - *Pleurolobus gangeticus* (L.) J.St.-Hil. ex H.Ohashi & K.Ohashi (Herb), *Prishniparni* - *Uraria picta* (Jacq.) Desv. ex DC. (Herb), *Brihati* - *Solanum anguivi* Lam. (Shrub), *Kantakari* - *Solanum virginianum* L. (Herb) and *Gokshura* - *Tribulus terresrtis* L. (Herb) (2). Due to its miraculous therapeutic properties such as anti-inflammatory, analgesic, anti-pyretic, antioxidant, anti-biotic, expectorant, anti-helminthic, anti-rheumatic, anti-bronchitis, anti leukodermatic and anti-anorexic activity it is praised worldwide as a potent *Ayurvedic* formulation (3, 4).

Patala botanically identified as *Stereospermum suaveolens* DC. belonging to family Bignoniaceae is one of the combination plants of *Dashmoola* (5). *Patala* as a single entity is widely used to treat various ailments such as *Aruchi* (Anorexia or loss of appetite), *Svasa* (Asthma), *Shotha* (Edema), *Rakta vikara* (Blood disorders), *Chardi* (Vomiting), *Hikka* (Hiccups), *Trishna* (Excessive thirst), *Raktapitta* (Hemorrhagic conditions), *Arsa* (Hemorrhoids), *Amlapitta* (Hyperacidity), *Mootravikara* (Urinary tract disorders), *Agnidagdhavrana* (Burn wounds), *Vrana Ruja* (Pain associated with wounds or ulcers), *Visphota* (Blisters), *Medoroga* (Obesity), *Kaphavatajavikara* (Disorders caused by *Kapha* and *Vata*

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imbalance), *Vatapaittikavikara* (Disorders caused by *Vata* and *Pitta* imbalance), *Ardhavabhedaka* (Migraine), *Vatavyadhi* (Neurological disorders), *Atisara* (Diarrhea), *Hridroga* (Heart disease), *Kasa* (Cough), *Mootraghata* (Urinary retention or obstruction), *Ashmari* (Urinary calculi), *Shukradaurbalya* (Seminal weakness), *Jwara* (Fever), *Shosha* (Emaciation), *Aadhman* (Flatulence or abdominal distension), *Sannipata* (vitiation of all three Doshas) and *Strotorodha* (Blockage of bodily channels) (6,7,8).

The plant bears chemical constituents such as naphthoquinone, lapachol [2-hydroxy-3-(3-methyl-2 butenyl)-1,4-naphthoquinone], Saponin, Stereolensin (5,7,3',4' tetrahydroxy-6-O-β-D-glucopyranosylflavone), various higher carboxylic acids. Root bark possesses β-sitosterol, n-triacontanol, Bitter substances. Root heartwood contains Lapachol, dehydro-α-lapachone and dehydrotectol, β-sitosterol. Bark yields a dark coloured gum, crystalline bitter substances, Specioside, Iridoid glycoside. Leaves possess flavones glycoside, Scutellarein, lapachol, 6 glucosylayleuteolin. Seed contains dark green non-drying fatty oil (5%). Flowers contains mucilage, albumin, sugar, wax and saccharine. Root contains majorly Lapachol, triacontanol and other constituents such as β-sitosterol, bitter substances, sterols, glycosides, Glyco-Alkaloids, dehydro-α-lapachone and dehydrotectol, lignin, ceryl alcohol, oleic acid, palmitic acid and stearic acid. Wood possesses (Dry basis) α-cellulose, 45.6; pentosan, 13.2; lignin, 31.0; and ass, 1.3%. Destructive distillation of the wood gave charcoal, 31.8; total distillate (Dry) ,49.0; pyroligneous acid (Dry), 37.7; tar, 11.3; acetone,3.17; methanol ,1.3; and pitch and losses, 1.1% (9). As per *Ayurveda* root bark of *patala* is used in different dosage forms, such as *kwatha* (decoction), *churna* (powder), and others (10).

Apart from its utility as an ingredient in *Dashmoola*, it is popularly used as a single drug and also in numerous formulations such as *Panchamuladi kwatha*, *Pataladi kwatha*, *Bruhatapanchamula kwatha*, *Bruhatapanchamuladi kadha*, *Patali taila*, *Dhanwantari taila*, *Prabhajanavimardana taila*, *Madhyamnarayan taila*, *Mushakadya taila*, *Vayukshaya Surendra taila*, *Indukanta ghrita*, *Dadhika ghrita*, *Mahapanchagavya ghrita*, *Dhanvantara ghrita*, *Lasunadi ghrita*, *Amritarishta*, *Dantyarishta*, *Bharangi guda*, *Brahma Rasayana*, *Chyavanaprashavaleha*, *Mritasanjeevanisura*, *Agastiharitaki Rasayana* (11,12,13).

According to classical references, the root barks of the *Dashmoola* are informed to be used while compounding any of the formulation (14). But, repeated interruptions of the root may affect the proper growth and development of the plant. On the other hand, the drug is attaining huge demand in the society. Looking in to this Government of India, in API has approved the utility of Stem / Stem bark in place of Root / Root Bark (15). But whether these replacements will provide the same kind of therapeutic attributes or not is unclear. Considering this, an attempt has been made to study whether the Stem bark can be considered as an official substitute for Root bark of plant *Patala*, (*Stereospermum suaveolens* DC.).

Materials and Methods

Collection of the trial drugs

The root bark and stem bark of *Stereospermum suaveolens* DC. (*Patala*) were procured from Khuta amba village of Dediyapada forest, district Narmada, Gujarat under the guidance and appropriate acceptance by Pharmacognosist. A voucher specimen of the trial drugs was preserved in the museum of the Department of Dravyaguna, I.P.G.T. and R.A., Jamnagar.

Pharmaceutical method of the trial drug

The root bark and stem bark sample were shade dried and converted into coarse powder. One part of trial drug and 16 parts of water was collected in a clean vessel and boiled until it was reduced to 1/8th of the initial quantity. Then it was filtered through a clean cloth to gain the *Kashaya* (Decoction) (16).

Instruments and chemicals used

Instruments such as Weighing scale, monopan balance, syringe, needle, catheters, plethysmograph were utilized. Chemicals such as Carrageenan, Normal saline were utilized for the pharmacological study.

Dose fixation and schedule

Decoction of the sample of *Patala* was prepared according to standard procedure. Human dose is 80 ml/day for both the samples. Now, human dose was converted into experimental dosage form i.e. rat dose and calculation were done on the basis of body surface area ratio using the table of Paget and Barnes (17). The animal dose of decoction was settled as 8 ml/kg body weight. The trial drug and vehicle were administered to control group as per body weight of the animal by oral route with the help of gastric catheter of suitable size sleeved to a syringe nozzle.

Animals and grouping

Wistar strain albino rats of either sex weighing between 170 gm – 200 gm were used for experimental study. The animals were obtained from the animal house attached to the pharmacology laboratory of I.P.G.T. & R.A. Animals were exposed to natural day and night cycles with ideal laboratory condition in terms of ambient temperature (22 ± 2ºC) and humidity (50 –60%). They were fed with Amrut brand rat pellet feed supplied by Pranav Agro Industries and tap water given as desired. All the experiments were carried out after obtaining permission from committee"(Vide No. IAEC-04/08-10/M. Pharm.05).

In total 18 animals, irrespective of sex were randomly selected and grouped into 3 groups. Group A comprises of water control, Group B comprises of Root bark *Kwatha* (Decoction) of *Patala* and Group C comprises of Stem bark *Kwatha* (Decoction) of *Patala*, each group incorporating 6 animals.

Selection of experimental model

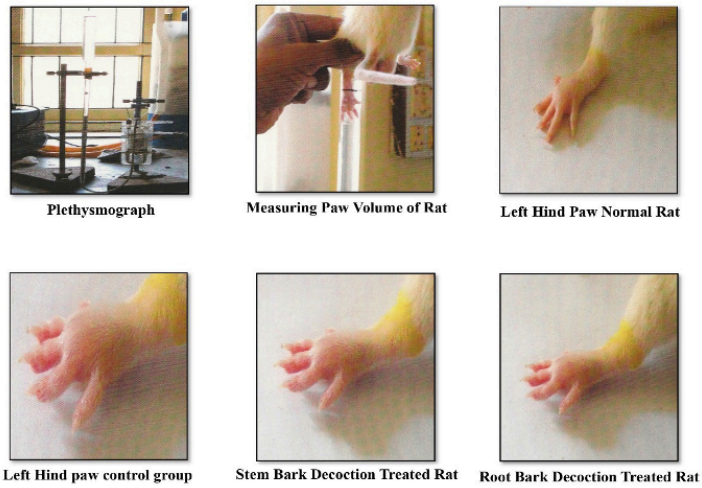
Carrageenan induced paw edema experimental model was employed to examine the anti-inflammatory activity from Winter et al (18).

Experimental procedure

Rats were administered with food and tap water up to the start of experiment. The rats were divided into three groups of six each. Group A was treated with tap water. Group B and Group C were treated orally with different samples of *Kwatha* (Decoction) of Root bark and Stem bark respectively for five consecutive days. Initially left hind paw volumes up to the tibio-tarsal articulation were recorded by using plethysmograph. On fifth day one hour after drug administration edema was produced by injecting 0.1 ml freshly prepared 1% carrageenan in sterile saline solution to the sub-plantar aponeurosis of the left hind limb. The rats were administered with tap water in the dose of 2 ml per 100 g body weight to ensure uniform hydration and hence to minimize

variations in edema formation. Paw volume was recorded three hours after carrageenan injection. [Figure 1]

Figure 1: Measurement and Observation of experimental Model for Inflammation



Statistical Analysis

The Student's unpaired t-test was employed for statistical analysis because the study compared two independent experimental groups. Although the group size were equal, the observation in the treated group were variably independent of those in the control group. Since there was no biological pairing or repeated measures taken on the same subjects across both groups, the unpaired t-test is the mathematically appropriate tool to compare the inter-group mean differences. So, Students' "t" test for unpaired data has been used for analyzing the data generated during the study. Results were demonstrated as Mean±SEM. A ' P ' value less than 0.05 is considered as statistically significant, the value of P<0.01 or P<0.001 is considered statistically highly significant.

Results

Preliminary Phytochemical Screening revealed that the presence of tricantanol in the chloroform extract of both the root bark and stem mark of Patla into the Stereospermum surveillance DC break a door however triacontanol was not detected in the aqueous extracts into the bracket decoctions of either sample.

Despite the absence of triacontanol the in vivo pharmacological evaluation using the paw oedema model demonstrated that the aqueous decoction of both samples exhibited ant- inflammatory activity. An apparent decrease in paw oedema was observed in both *Patala* decoction treated groups when compared to the control group.

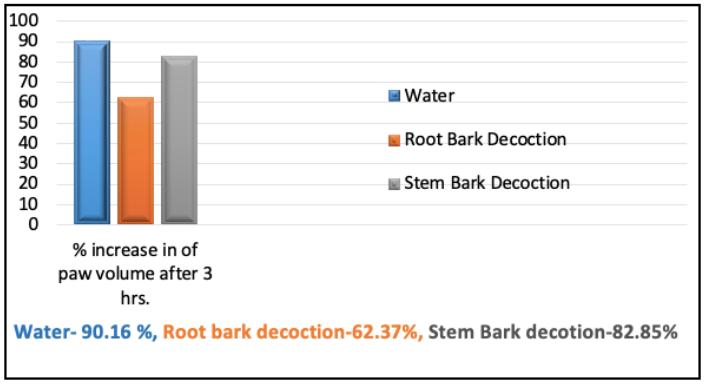
The result of anti-inflammatory activity showed that group B (Treated with root bark decoction) exhibited 30.82% separation of inflammation which was found to be statistically significant. In contrast, Group C (treated with steam bark decoction) showed a much lower suppression rate of 08.10%, Which did not reach the statistically significant compared to the control group [Table 1] [Graph 1]

Table 1: Statistical analysis of two different samples of *Patala* decoction on Carrageenan induced paw edema in albino rats

Group	Drug	Dosage (mL/kg)	% increase in of paw volume after 3 hrs.	Percentage change
A	Water	Q.S.	90.16 ± 1.77	-
B	Root bark decoction	3.6	62.37 ± 6.73*	30.82 ↓
C	Stem bark decoction	3.6	82.85 ± 5.62	08.10 ↓

↓ = Decrease. *P<0.01 (comparison to control group, unpaired t test)

Graph 1: Effect of *Patala* Root bark decoction and Stem bark decoction on carrageenan induced paw edema in albino rats



Discussion

The present study aimed to evaluate and compare the anti-inflammatory efficacy of the Root bark and Stem bark of *Patla* (*Stereospermum chelanoides* DC.) a crucial ingredient of the classical *Ayurvedic* formulation *Dashamoola.*

Root Bark and Stem Bark Efficacy Comparison

While Classical *Ayurvedic* texts fundamentally prescribe the Root bark of *Patala* to achieve optimal therapeutic effects (19), other treatises propose the substitution principle (*Abhava Pratinidhi Dravya*) suggesting that different parts of the same plant possess similar pharmacological properties and actions (20). Our experimental data challenges the absolute equivalence of these parts. The Root bark decoction (Group B) significantly suppress oedema (30.82%), where is the Stem bark decoction (Group C) showed non-significant suppression (08.10%). This confirms the traditional preference for root bark in formulation like the *Dashamoola*.

Interpretation of Phytochemical-Pharmacological Divergence

A key finding of this study is the disparity between the chemical presence of triacontanol and the observed therapeutic effect. Previous literature identifies triacontanol as a potent anti-inflammatory constituent present in *Patala* (21). Chloroform extracts confirmed its presence in both Root bark and Stem bark. But, the traditional *Ayurvedic* dosage form the aqueous decoction (*Kwatha)* exhibited no traces of triacontanol. Although, the decoction still showed notable anti-inflammatory activity. This strongly indicates that the anti-inflammatory properties of the aqueous decoction (*Kwatha*) are driven by synergistic water

soluble phytoconstituent such as flavonoids, tannins or water-soluble glycosides rather than the lipid soluble triacontanol.

Comparison with previous Literature

These findings are consistent and broader pharmacological studies on the *Dashmoola* group of plants, which frequently report that Root bark contain higher concentration of secondary metabolites due to the Root system's role in synthesizing and storing specific defensive alkaloids and Phenols. Some recent conservation driven research as suggested for using Stem bark to prevent the destructive harvesting of these roots. Findings align with studies indicating that 1:1 substitution often leads to compromised clinical efficacy

Limitation of the Study

The anti-inflammatory activity was evaluated using only an acute model (paw oedema). Chronic inflammatory models were not explored. The study concludes that water-soluble compounds are responsible for the therapeutic effect but, the specific active compound in the aqueous extract were not isolated or quantified. The study compared equal doses of root bark and stem bark. It did not explore whether a higher dose of stem bark could achieve the therapeutic similarity of the root bark.

Conclusion

This study showed that the root bark of *Stereospermum chelonoides* (*Patala*) has significant higher anti-inflammatory activity than the stem bark at equal doses in the acute carrageenan model. However, the stem bark cannot be completely ruled out as a substitute based on this single model. Future studies must focus on isolating the active water-soluble compounds responsible for the therapeutic effect of the traditional aqueous decoction (*Kwatha).* Additionally, evaluating the stem bark in chronic inflammatory models and conducting dose-response studies are highly recommended. Determining if a higher, safe dose of stem bark can match the efficacy of the root bark will be crucial for developing a sustainable harvesting alternative and preventing the destructive uprooting of this medicinal plant.

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