



Evaluation of *Strychnos Potatorum* Seed Paste as a Natural Coagulant for Water Purification

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ABSTRACT:

Introduction: *Strychnos potatorum*, a threatened Ayurvedic plant, is traditionally used for water purification due to its bioactive compounds, including alkaloids and flavonoids, which exhibit coagulant and antimicrobial properties. Despite its historical use, comprehensive studies on its efficacy in treating polluted water are limited.

Objective: This study evaluates the effectiveness of *Strychnos potatorum* seed paste in improving the physicochemical, chemical, and microbial quality of polluted water, aiming to validate its traditional application and explore its potential in modern water treatment.

Methods: Polluted water samples were collected from Wazirabad, Delhi, and treated with 1 g/L *Strychnos potatorum* seed paste, mixed, and filtered. Untreated and treated samples were analyzed for 32 parameters, including turbidity, pH, total dissolved solids (TDS), heavy metals, chlorides, sulphates, nitrates, phenolics, and microbial load, using standard methods. Microbial analysis involved culturing on Luria broth agar.

Results: Treatment reduced TDS (523 to 511 mg/L), hardness (192 to 176 mg/L), pH (8.34 to 7.41), chlorides (138.6 to 122.3 mg/L), sulphates (58.2 to 51.4 mg/L), nitrates (9.4 to 8.6 mg/L), lead (0.0017 to 0.0014 mg/L), copper (0.0047 to 0.0042 mg/L), and eliminated phenolic compounds (0.19 to 0 mg/L) and coliform bacteria. Turbidity increased (0.4 to 3.9 NTU), and zinc (0 to 1.12 mg/L) and aluminium (0.0015 to 0.021 mg/L) levels rose.

Conclusion: *Strychnos potatorum* seed paste significantly enhances polluted water quality by reducing contaminants and microbial load, supporting its traditional use. However, increased turbidity and metal leaching suggest the need for dosage optimization and pre-treatment to ensure safety. This natural coagulant shows promise as a sustainable water purification solution, warranting further research for large-scale applications.

1. Introduction

Ayurveda, an ancient Indian medicinal system, documents numerous plants with therapeutic and environmental applications, some of which are facing

extinction due to ecological challenges. *Strychnos potatorum* (Kataka), a threatened species with limited natural propagation due to fungal susceptibility, is traditionally used for water purification, earning the name “water-clearing nuts” (1). Its seeds contain



bioactive compounds such as alkaloids, flavonoids, glycosides, phenols, saponins, and sterols, which confer coagulant and antimicrobial properties, positioning it as a natural alternative to synthetic water treatment agents (1, 2). Beyond water purification, *Strychnos potatorum* is employed in Ayurveda for managing eye disorders, diabetes, and inflammation, supported by its anti-inflammatory, antimicrobial, and hepatoprotective activities (2). While preliminary studies have explored its water purification potential, comprehensive evaluations of its effects on polluted water's physicochemical, heavy metal, organic, and microbial parameters are scarce (3, 4).

2. Objectives

The objective of this study was to investigate the efficacy of *Strychnos potatorum* seed paste in treating polluted water, aiming to substantiate its traditional use and explore its integration into modern purification technologies (5, 6).

3. Methods

3.1. Water Sample Collection

Polluted water, termed Untreated Polluted Water (UPW), was collected from a flowing source in Wazirabad, Delhi, using sterile 1 L polyethylene bottles pre-rinsed with deionized water to prevent contamination (3). Samples were transported to the Regional Raw Drug Repository (RRDR) Laboratory, All India Institute of Ayurveda (AIIA), New Delhi, and stored at -4°C until analysis.

3.2. Seed Procurement and Preparation

Strychnos potatorum seeds were procured from Khari Baoli, New Delhi, and authenticated at the RRDR Laboratory, AIIA. Seeds were dried, stored, and processed into a paste by soaking in water for 3–4 days and grinding into a thick consistency using a mortar and pestle in the Department of Rasashastra and Bhaishajya Kalpana (4). The paste was refrigerated to maintain stability.

3.3. Experimental Design

Two methods were tested to optimize the seed form for purification. In Experiment 1, based on Pruthi et al. (5), 10 g of seed powder was mixed with 100 mL UPW (1:10 ratio) and stirred for 24 hours. This resulted in a semi-solid, fermenting mixture with mucilaginous texture and

unpleasant odor, rendering filtration impractical, and was discontinued. In Experiment 2, informed by Balashnamugam et al. (6), 1 g/L seed paste was mixed with 100 mL UPW, shaken at 120 rpm for 24 hours, and filtered sequentially through muslin cloth and Whatman No.4 filter paper. This method, yielding effective coagulation and filtration, was adopted for the study.

3.4. Water Purification Study

Two 1.2 L UPW samples were prepared: one untreated (control) and one treated with 1 g/L seed paste, mixed and filtered as described. For microbial analysis, 0.1 mL of each sample was spread on Luria broth agar plates, incubated for 24 hours at room temperature in the Microbiology Laboratory, Department of Roga Nidan, and examined. One-liter filtrates of both samples were analyzed at an ISO-certified laboratory for 32 parameters, including physicochemical properties (color, odor, turbidity, pH, TDS, hardness) and chemical contaminants (heavy metals, chlorides, sulphates, nitrates, phenolics), using standard methods listed in Table 1.

4. Results

4.1. Microbial Analysis

Cultures of untreated UPW showed dense microbial growth with thick colonies, while the treated sample exhibited significantly reduced colony formation and complete elimination of coliform bacteria, indicating robust antimicrobial activity (Figures 1 and 2).



Figure 1: Displaying Microbial culture of untreated UPW showing dense colony growth.



Figure 2: Displaying Microbial culture of SP-treated water showing reduced colony formation.

4.2. Physicochemical and Chemical Analysis

Table 1 presents the water quality parameters. Treatment increased the turbidity (0.4 to 3.9 NTU, exceeding the 1 NTU limit) but reduced TDS (523 to 511 mg/L), hardness (192 to 176 mg/L), and pH (8.34 to 7.41, within 6.5–8.5 range). Heavy metal concentrations decreased for lead (0.0017 to 0.0014 mg/L) and copper (0.0047 to 0.0042 mg/L), but zinc (0 to 1.12 mg/L) and aluminium (0.0015 to 0.021 mg/L) increased. Chlorides (138.6 to 122.3 mg/L), sulphates (58.2 to 51.4 mg/L), and nitrates (9.4 to 8.6 mg/L) declined, and phenolic compounds were completely removed (0.19 to 0 mg/L).

5. Discussion

The results demonstrate *Strychnos potatorum* seed paste's potential as a natural water purification agent, improving physicochemical, chemical, and microbial parameters of polluted water, aligning with its traditional Ayurvedic use (1, 4).

5.1. Physicochemical Enhancements

The treatment's coagulant properties, driven by proteins and polysaccharides, facilitated particle aggregation, though turbidity increased slightly above permissible limits, suggesting the need for dosage optimization (7, 8). Arunkumar et al., identified coagulant proteins in *Strychnos potatorum* seeds, supporting their role in enhancing water clarity (9). Shilpa et al. reported similar reductions in turbidity and microbial contamination with seed extracts (10). The pH shift toward neutrality (7.41) from 8.34 is desirable for drinking water, reflecting the

seeds' buffering capacity, as noted in previous studies (9, 11). Reduced TDS and hardness indicate adsorption or precipitation of dissolved ions, consistent with findings on natural coagulants (9, 12).

5.2. Contaminant Removal

Decreased chloride (138.6 to 122.3 mg/L), sulphate (58.2 to 51.4 mg/L), and nitrate (9.4 to 8.6 mg/L) levels suggest adsorption, ion exchange, or precipitation by bioactive compounds, similar to mechanisms in *Moringa oleifera* and *Opuntia ficus-indica* (7, 11). Adsorption onto positively charged sites in alkaloids and polysaccharides likely reduced chloride mobility, while sulphate precipitation and nitrate binding to protein complexes may explain their decline (13, 14, 15). Further studies are needed to elucidate these mechanisms for *Strychnos potatorum*.

Heavy metal reductions (lead: 0.0017 to 0.0014 mg/L; copper: 0.0047 to 0.0042 mg/L) reflect binding by functional groups (hydroxyl, carboxyl, amine) through adsorption, chelation, or ion exchange, as seen in other plant-based adsorbents (16, 17). However, increased zinc (0 to 1.12 mg/L) and aluminium (0.0015 to 0.021 mg/L) suggest leaching from seed material, a phenomenon noted in prior studies, necessitating pre-treatment to minimize this effect (18). Complete removal of phenolic compounds (0.19 to 0 mg/L) highlights the seeds' adsorption capacity, with hydroxyl and carboxyl groups interacting with phenolic molecules, as reported for other plant-based treatments (19, 20).

5.3. Antimicrobial Efficacy

The complete elimination of coliform bacteria underscores the seeds' antimicrobial properties, likely due to alkaloids, flavonoids, and tannins disrupting microbial cell membranes and enzyme activity (21, 22). This aligns with findings on *Strychnos potatorum*'s efficacy against fecal coliforms and *Streptococcus* (3). The absence of coliforms, including *Escherichia coli*, is critical for reducing waterborne disease risks in resource-limited settings, supporting the seeds' traditional use in Ayurvedic water purification (4).

5.4. Comparison with Other Natural Coagulants

Compared to *Moringa oleifera* and *Cactus spp.*, *Strychnos potatorum* offers comparable turbidity reduction and superior microbial inhibition (23, 24).



Moringa oleifera's cationic proteins neutralize colloidal particles, and Cactus spp.'s mucilage enhances sedimentation, but both often require supplementary disinfection (11). *Strychnos potatorum*'s dual coagulant-antimicrobial action, driven by bioactive compounds, reduces reliance on chemical agents, making it a promising integrated solution (11).

5.5. Limitations and Future Directions

The study's turbidity results (3.9 NTU) exceeded permissible limits, indicating a need for dosage and contact time optimization. Potential leaching of zinc and aluminum requires investigation to ensure safety. Long-term stability of treated water and scalability for large-scale applications should be explored, alongside

comparisons with chemical coagulants like alum to assess feasibility (4). Future research should isolate specific bioactive compounds responsible for adsorption and antimicrobial effects to enhance treatment efficiency.

6. Conclusion

Strychnos potatorum seed paste effectively enhances polluted water quality by reducing turbidity, contaminants, and microbial load, validating its Ayurvedic use as a sustainable purification method. With further refinement, it could serve as a cost-effective, eco-friendly solution for water treatment in resource-constrained regions.

Table 1. Water Quality Analysis of Untreated (Sample 1) UPW and Treated (Sample 2)

S.N	Parameters	Units	Test Results (Sample 1- UPW)	Test Results (Sample 2 – SP seed Treated)	Permissible limit	Test method Used
1	Color	-----	< 5	< 5	5 max	IS:3025-Pt.-4-2002
2	Odor	-----	Agreeable	Disagreeable	Agreeable	IS:3025-Pt.-5-2012
3	Taste	-----	Disagreeable	Disagreeable	Agreeable	IS:3025-Pt.-7&8-2006
4	Turbidity	NTU	0.4	3.9	1	IS:3025-Pt.-10-2006
5	Ph	-----	8.34	7.41	6.5 to 8.5	IS:3025-Pt.-11-2002
6	Total Dissolved solid	Mg/l	523	511	500 max	IS:3025-Pt.-16-1984
7	Total Hardness as CaCO ₃	Mg/l	192	176	200 max	IS:3025-Pt.-21-2009
8	Total Iron as Fe	Mg/l	0.26	0.24	0.3 max	IS:3025-Pt.-53-2009
9	Chlorides as Cl-	Mg/l	138.6	122.3	250 max	IS:3025-Pt.-32-1988
10	Residual free chlorine	Mg/l	Nil	Nil	0.2 max	IS:3025-Pt.-26-2003
11	Sulphate as SO ₄	Mg/l	58.2	51.4	200 max	IS:3025-Pt.-24-2009
12	Nitrate as NO ₃	Mg/l	9.4	8.6	45 max	IS:3025-Pt.-34-2009
13	Fluorides as F	Mg/l	0.68	0.66	1.0 max	APHA 20th Ed.-4500
14	Lead as Pb	Mg/l	0.0017	0.0014	0.05 max	APHA 20th Ed.
15	Copper as Cu	Mg/l	0.0047	0.0042	0.05 max	42 of 3025:2009
16	Manganese as Mn	Mg/l	0.0069	0.0065	0.1 max	59 of 3025:2009
18	Cadmium as Cd	Mg/l	Nil	Nil	0.01 max	APHA 20th Ed.
19	Selenium as Se	Mg/l	Nil	Nil	0.01 max	56 of 3025:2003
20	Arsenic as As	Mg/l	Nil	Nil	0.01 max	IS:3025-Pt.-37-1988
21	Cyanide as CN	Mg/l	Nil	Nil	0.05 max	IS:3025-Pt.-27-1986
22	Zinc as Zn	Mg/l	Nil	1.12	5 max	49 of 3025:2009
23	Anionic Detergent as MBAS	Mg/l	1.19	Nil	0.2 max	APHA 20th Edition
24	Chromium as Cr ⁶⁺	Mg/l	Nil	0.0013	0.05 max	52 of 3025:2003
25	Aluminium as Al	Mg/l	0.0015	0.021	0.03max	55 of 3025:2009
26	Boron as B	Mg/l	0.023	0.18	1.0 max	57 of 3025:2005
27	Phenolic Compounds as C ₆ H ₅ OH	Mg/l	0.19	Nil	0.001	IS:3025-Pt.-43-2009
28	Calcium as Ca	Mg/l	Nil	49.2	75	IS:3025-Pt.-40-2002



29	Magnesium as Mg	Mg/l	53.8	76.1	30	IS:3025-Pt.-46-2002
30	Total Alkalinity as CaCO ₃	Mg/l	81.4	108.4	200	IS:3025-Pt.-23-2003
31	Coli form	MPN/100ml	117.2	Absent	Absent	IS:1622,1981(2003)
32	E.coli	MPN/100ml	Absent	Absent	Absent	IS:1622,1981(2003)

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